

QA/QC Practices for Procurement of Steam Turbine and Generator Equipment



QA/QC Practices for the Procurement of Steam Turbine and Generator Equipment

EPRI Project Manager
G. Golden



3420 Hillview Avenue
Palo Alto, CA 94304-1338
USA

PO Box 10412
Palo Alto, CA 94303-0813
USA

800.313.3774
650.855.2121

askepri@epri.com

www.epri.com

1024903

Final Report, February 2012

DISCLAIMER OF WARRANTIES AND LIMITATION OF LIABILITIES

THIS DOCUMENT WAS PREPARED BY THE ORGANIZATION(S) NAMED BELOW AS AN ACCOUNT OF WORK SPONSORED OR COSPONSORED BY THE ELECTRIC POWER RESEARCH INSTITUTE, INC. (EPRI). NEITHER EPRI, ANY MEMBER OF EPRI, ANY COSPONSOR, THE ORGANIZATION(S) BELOW, NOR ANY PERSON ACTING ON BEHALF OF ANY OF THEM:

(A) MAKES ANY WARRANTY OR REPRESENTATION WHATSOEVER, EXPRESS OR IMPLIED, (I) WITH RESPECT TO THE USE OF ANY INFORMATION, APPARATUS, METHOD, PROCESS, OR SIMILAR ITEM DISCLOSED IN THIS DOCUMENT, INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, OR (II) THAT SUCH USE DOES NOT INFRINGE ON OR INTERFERE WITH PRIVATELY OWNED RIGHTS, INCLUDING ANY PARTY'S INTELLECTUAL PROPERTY, OR (III) THAT THIS DOCUMENT IS SUITABLE TO ANY PARTICULAR USER'S CIRCUMSTANCE; OR

(B) ASSUMES RESPONSIBILITY FOR ANY DAMAGES OR OTHER LIABILITY WHATSOEVER (INCLUDING ANY CONSEQUENTIAL DAMAGES, EVEN IF EPRI OR ANY EPRI REPRESENTATIVE HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES) RESULTING FROM YOUR SELECTION OR USE OF THIS DOCUMENT OR ANY INFORMATION, APPARATUS, METHOD, PROCESS, OR SIMILAR ITEM DISCLOSED IN THIS DOCUMENT.

REFERENCE HEREIN TO ANY SPECIFIC COMMERCIAL PRODUCT, PROCESS, OR SERVICE BY ITS TRADE NAME, TRADEMARK, MANUFACTURER, OR OTHERWISE, DOES NOT NECESSARILY CONSTITUTE OR IMPLY ITS ENDORSEMENT, RECOMMENDATION, OR FAVORING BY EPRI.

THE FOLLOWING ORGANIZATION, UNDER CONTRACT TO EPRI, PREPARED THIS REPORT:

Power Plant Professionals, LLC

NOTE

For further information about EPRI, call the EPRI Customer Assistance Center at 800.313.3774 or e-mail askepri@epri.com.

Electric Power Research Institute, EPRI, and TOGETHER...SHAPING THE FUTURE OF ELECTRICITY are registered service marks of the Electric Power Research Institute, Inc.

Copyright © 2012 Electric Power Research Institute, Inc. All rights reserved.

Acknowledgments

The following organization, under contract to the Electric Power Research Institute (EPRI), prepared this report:

Power Plant Professionals, LLC
975 Market Street, Suite 201D
Fort Mill, South Carolina 29708

Principal Investigators
T. Rosiak
M. Campbell
W. Eargle

This report describes research sponsored by EPRI.

The EPRI turbine-generator programs would like to acknowledge the following technical advisory group members and other member-utility personnel for their contributions during the development of this guide.

TAG Members

Danny Chiou
Kevin Purkey
Mike West
Hobson G. Best
James Wieters

Utility

Exelon
Southern Company Services
TVA
TVA
SCANA

Other

Henry Botkins Duke Energy

This publication is a corporate document that should be cited in the literature in the following manner:

*QA/QC Practices for the
Procurement of Steam Turbine and
Generator Equipment.*
EPRI, Palo Alto, CA: 2012.
1024903.

Product Description

Procuring steam turbine-generator (STG) equipment is a major undertaking for a power producer. The critical nature of STG components in a generating facility and the impacts on cost, performance, and output dictate that the procurement process be managed with the utmost skill and efficiency, and quality is a high priority at every stage of a procurement project. This Electric Power Research Institute (EPRI) report presents recommended quality assurance (QA) and quality control (QC) practices for the procurement of STG equipment.

Background

A strong QA/QC program is an essential part of any successful project such as the procurement and installation of replacement steam turbine generating equipment. The QA/QC program provides for formal oversight of project activities and requirements and provides for feedback on project execution during all phases of the project so that modifications, when necessary, can be implemented in a timely fashion. The QA/QC program oversees procedures and processes for developing the requisite standards, and it defines requirements for successful project execution and monitoring of execution through timely inspections, site visits, status review meetings, review of work packages, and vendor certifications.

Objectives

The intent of this guide is to capture the steps that should be taken to ensure that the proper QA/QC methods are applied to the process of procuring STG equipment, including the prerequisites, bidding and contracting, design, manufacturing, installing, and commissioning.

Approach

This report was developed by reviewing existing EPRI reports and relevant public documents and obtaining input from various utility and manufacturing sources. The information was then organized and reviewed by a technical advisory group (TAG) to ensure that the report adequately addresses the issues.

Results

Most utilities and major suppliers have procurement processes and quality plans. However, in spite of everyone's best intentions, there can still be failures if attention is not paid to potential pitfalls in several areas. A number of factors can lead to failure during the procurement process, but a strong QA/QC program can mitigate these factors and improve the success rate for STG retrofit and replacement projects.

The keys to success are:

- Assembling a strong and experienced project team
- Utilizing clear and complete specification and bid documents
- Providing effective oversight of the design, manufacturing, installation, and commissioning
- Implementing a formal auditing program with proactive follow-up

Applications, Value, and Use

The information provided in this report will help plant managers, procurement managers, and design and engineering departments improve the success of steam turbine-generator retrofit and replacement projects.

Keywords

Quality assurance
Quality control
QA/QC
Procurement
Steam turbine-generator
STG

Table of Contents

Section 1: Introduction.....	1-1
Section 2: Overview	2-1
Section 3: The Project Team and Overall Process	3-1
3.1 Staffing Requirements and Skill Sets	3-1
3.2 Outsourcing	3-5
3.3 Implementing QA/QC Throughout the Procurement Process	3-7
3.3.1 Technical Information and Requirements	3-9
3.3.2 Schedule and Budgeting.....	3-9
Section 4: Bid and Contract Documents	4-1
4.1 Bid Document Preparation.....	4-1
4.2 Instructions to Bidders	4-2
4.3 Specification	4-3
4.3.1 Technical Requirements	4-4
4.3.2 Quality Requirements	4-4
4.3.3 Supplier Documentation Requirements.....	4-9
4.4 Qualifying Bidders	4-10
4.4.1 Evaluating Past Performance	4-10
4.4.2 Determining Current and Future Capabilities.....	4-11
4.4.3 Preparing for the Unknown	4-13
4.5 Bid Evaluation	4-13
4.5.1 Commercial Terms	4-15
Section 5: Design, Manufacturing, and Installation Oversight	5-1
5.1 Review Meetings.....	5-2
5.2 Inspections and Hold Points.....	5-4
5.2.1 Inspections and Walk-Throughs	5-4
5.2.2 Hold Points	5-4
Section 6: References.....	6-1

List of Figures

Figure 2-1 Typical owner and supplier organizations	2-3
Figure 3-1 Generic process for considering key issues when procuring STG equipment	3-8
Figure 4-1 Two interpretations of 75% contact	4-6
Figure 4-2 Supplier selection and bid evaluation	4-14

List of Tables

Table 3-1 Typical project team for implementing an STG component upgrade	3-3
Table 3-2 Outsourcing considerations	3-6



Section 1: Introduction

Most utilities and major suppliers have procurement processes and quality plans. However, in spite of everyone's best intentions, there can still be failures if attention is not given to potential pitfalls in several areas. There are a number of factors that can lead to failure during the procurement process.

A strong quality assurance/quality control (QA/QC) program can mitigate these factors and improve the success rate for steam turbine-generator (STG) component retrofit and replacement projects.

The bottom-line success of a project depends on the following:

- Choosing the right team
- Developing an accurate technical and quality specification
- Choosing words that clearly define the required aspects of product quality being sought
- Establishing clear and open communications
- Defining witness and hold points to verify that the specification is being followed
- Adhering rigorously to the quality plan
- Auditing the quality plan to ensure that it is properly implemented and followed
- Acting quickly based upon any findings

This report provides guidance on implementing these QA/QC practices to support procurement of STG equipment.



Section 2: Overview

A strong QA/QC program is an essential part of any successful project such as the procurement and installation of replacement steam turbine-generator equipment. The QA/QC program provides for formal oversight of project activities and requirements and provides for feedback on project execution during all phases of the project so that modifications, when necessary, can be implemented in a timely fashion. The QA/QC program oversees procedures and processes for developing the requisite standards, and it defines requirements for successful project execution and monitoring of execution through timely inspections, site visits, status review meetings, review of work packages, and vendor certifications.

The key elements of an effective QA/QC program are the following:

- The project team
- Bid and contract documents
- Design, manufacturing, and installation oversight
- Planning, auditing, and follow-up

There are many significant issues and hurdles to address when major plant components, such as the STG, are to be replaced, including these:

- Capital cost
- Outage scheduling
- Capacity replacement during the outage
- Application of advances in technology
- Changes in operating parameters

All of these issues are important, but if the appropriate actions are not taken to ensure that the new component will meet its design, operating, and performance expectations, the project will not be considered a success. The result of a failure to ensure quality during execution of the procurement and installation process can result in financial and performance losses.

Factors that can lead to failure during the procurement process include the following:

- Poorly written specifications
- Changes in management
- Company policies
- Failure to follow written procedures
- Misunderstandings between the parties
- Cultural differences
- Corporate and departmental politics
- Subcontractor and supplier issues
- Inadequate skills and/or staffing levels
- Inadequate communications
- Inconsistent project execution

In considering such factors, the quality of the purchased equipment depends largely on the following attributes:

- **Attitude.** The entire project team must understand that achieving quality is not an option, but instead an essential element of the procurement process.
- **Knowledge.** Knowledge begins with a thorough understanding of the specification, the bid documents, and the contract.
- **Teamwork.** The suppliers, their subcontractors, installers, and other third-party companies must be included when developing and managing the quality plan.
- **Communication.** The methods and routing of communications needed need to be established to ensure clear understanding.
- **Inspections and testing.** Key ideas, testing criteria, and quality requirements must be identified, and rigorous testing and inspections are required.
- **Auditing.** The quality plan must be audited routinely and findings reported in a timely manner.
- **Corrective action.** Performance reporting, corrective actions, and continued diligent follow-ups are required.

Each of the various organizations within the project—owner, suppliers, and construction—will have goals and responsibilities specific to their organizations. Ultimately, it is the facility owner who has the greatest vested interest in the quality of the end product and success of the project. Although the equipment suppliers, constructors, and other third-party companies are all concerned about the quality of the equipment, they do not have the same perspective as the owner.

Their responsibilities are based on the terms of the purchase contract and are therefore relatively short and narrowly focused. It is therefore in the owner's best interest to ensure that a strong quality assurance and control program exists and is adhered to.

Each company has its own project management procedures and organizational structure with well-defined roles and responsibilities. Interfaces with suppliers and other outside organizations may vary widely and must be established. As an example, for an STG component replacement project, a typical owner and supplier interface structure, with organizations and responsibilities, is shown in Figure 2-1 [1].

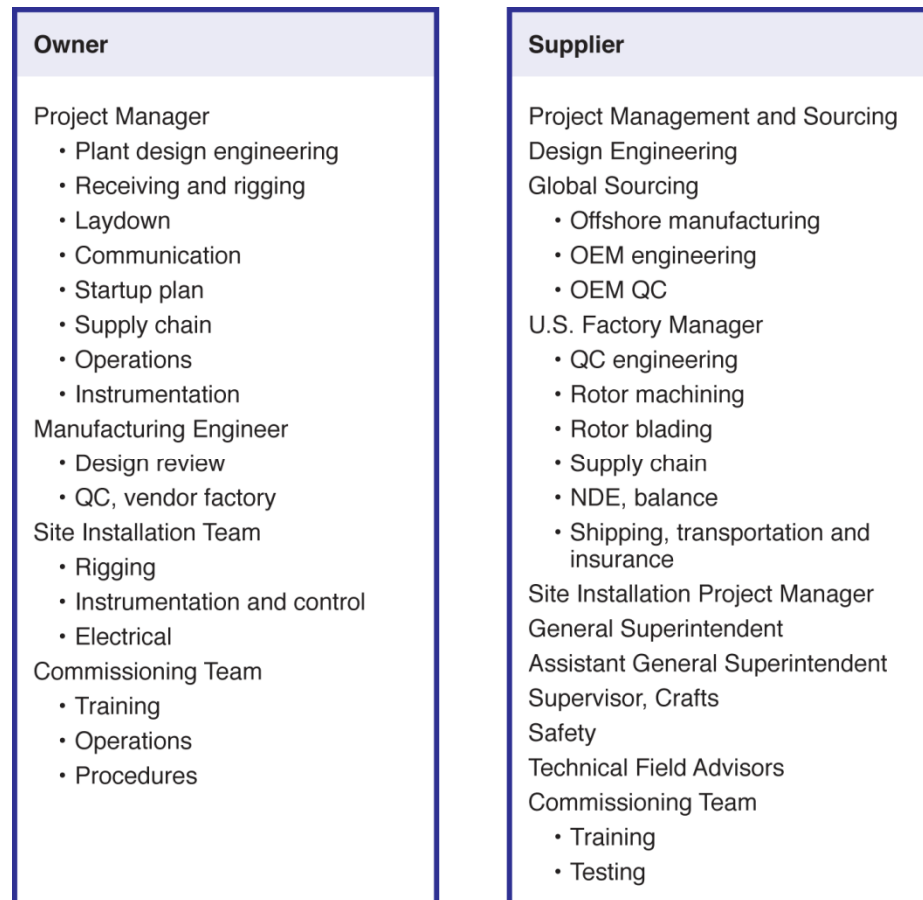


Figure 2-1
Typical owner and supplier organizations

The quality plan must be based on defined specifications, thorough documentation, inspections, and tests that will verify that each aspect of the project is properly executed.

All of the best plans are worthless if they are not properly implemented across all of the companies (owner, supplier, subcontractors, installer, shipper, and consultants) and various organizations and groups within the companies that are involved in the procurement of STG equipment.

It is important that all parts of the procurement process be addressed. Clear and frequent communications among the team members are critical, as are diligent follow-ups. A successful QA/QC program should be audited to ensure that it is being fully utilized and that it is functioning as envisioned. The risk to the plant operation and the financial performance of the facility is too important to be left to chance.

This report focuses on the steps required to implement QA/QC throughout the process of procuring STG equipment and on application of these principles to the key elements of the procurement process.

As an aid to developing and implementing the QA/QC process, there are a number of EPRI resources that can provide guidance on project management, procurement of equipment, and quality plans, including the reports listed below.

- **Developing the specification.** For detailed guidance on developing the specification, the reader can refer to the following EPRI reports:
 - Report 1022321, *Guidelines for Reducing the Time and Cost of Turbine-Generator Maintenance Overhauls and Inspections, Volume 4: Turbine-Generator Component Procurement Specifications* [2]
 - Report 1008256, *Plant Support Engineering: Guidelines for the Technical Evaluation of Replacement Items in Nuclear Power Plants* [3]
- **Project management.** The following EPRI report provides the process elements that should be included in procurement of major plant equipment, such as the STG. It also provides guidance on implementing the entire project:
 - Report 1014717, *Project Management Guidance When Upgrading Steam Turbines at Nuclear and Fossil Power Plants* [1]



Section 3: The Project Team and Overall Process

The project team dictates the success or failure of a project. Because the purchase of major components such as those in the STG systems happens infrequently during the life cycle of a plant, it is important that the proper project team resources are identified and assembled to execute the procurement of the equipment. One of the most significant contributors to the failure of equipment meeting its intended purpose is inconsistent project execution.

The project team has three primary responsibilities:

- Managing the cost
- Managing the schedule
- Ensuring that the equipment remains suitable for its intended application

The project team must have a clear understanding of the entire scope of work associated with upgrading or replacing STG equipment—the specification, the contract, the vendors, and third-party services. It is imperative that the project scope be defined early in the process. In addition, the project team must have the discipline to develop proper specifications and track the equipment against the specification throughout the procurement process. The owner's project management team controls the project using management tools such as the procurement process and QA/QC procedures.

The procurement process is the mechanism by which the project team can exercise control of the design, manufacture, and installation of the equipment. The project plan and the project quality plan provide the means for ensuring that the equipment will work as intended.

3.1 Staffing Requirements and Skill Sets

The procurement of STG equipment is complex, and the outcome will have a major impact on the financial performance of the plant and the company. The project team's scope and responsibilities must be defined up front because the quality begins with the selection of the project team. An experienced project manager and a strong project team are needed to effectively manage the project.

The project team should include personnel from the owner, supplier, subcontractors, and any third-party companies. They must all be involved in the development of the project procurement quality plan. The roles of any third-party consultants that are to be utilized should also be established.

The team should incorporate people with the most experience and the best relationship skills. It is critical to staff the team with people who have the right technical and management skills to minimize errors. The key owner's team members should have experience with similar work and be familiar with the vendors and equipment to be procured. Strong communications skills are another important requirement. The project team will establish methods and processes needed to ensure that the team understands the key ideas, testing criteria, and quality requirements, through the use of meetings, e-mails, and other correspondence to convey information on the project.

Each member of the project team must fully understand his or her role and responsibilities. The project schedule should provide sufficient detail to keep everyone informed on the project requirements. Project quality criteria should be measurable, and it is important to ascertain what the areas of concern are from the perspective of the owner, the supplier, and so on.

The project team organizational structure should be developed with all team member roles and responsibilities well defined. In general, the first position to be filled will be that of the project manager. A project manager with the right experiences and skill sets is critical to preventing failure. The project manager will be instrumental in forming the rest of the project team. This team should be a multidisciplinary group that guides a component replacement from beginning to end, although the team composition may change as the project moves through its life cycle. Information from the Institute for Nuclear Power Operations (INPO) suggests that for nuclear steam turbine upgrades, the most successful teams included a senior reactor operator during the entire process. For steam turbine upgrades at fossil power plants, a senior person from operations should be considered for inclusion on the team. Table 3-1 lists the typical organizations that may compose the project team, and the estimated extent to which they would be involved [1].

Table 3-1
 Typical project team for implementing an STG component upgrade

Organization	Anticipated Level of Involvement
Maintenance	Medium
Installer	High
Project manager	High
QA/QC	Medium
Work controller/planner/scheduler	High
Licensing	Low
Operation (senior/station reactor operator or equivalent)	High
Senior management	Medium
Component supplier	High
Plant security	Low
Training	Low (higher for maintenance personnel)
Supply chain	Low (during actual purchasing)
Health physics	Project dependent (based on application)
Chemistry management	Low (project dependent—based on application, chemistry should have input to the component specification if impacted by steam or cooling water conditions)

The key full-time positions should be staffed as required to support the overall project schedule. Some team members may not be assigned to the project on a full-time basis, but should know in advance what their roles and responsibilities are on the project. They also need to be included in project communications and any meetings that may relate to their areas of expertise or responsibility.

Indeed, it is often the case that many kinds of expertise (both internal and external to the utility—for example, the skills of a performance test engineer) are essential at almost every stage of product development and usage. Therefore, the project manager should solicit, and be provided with, a variety of expertise concurrently during each stage of the sequential process [1].

Common traps that power generating companies fall into when staffing the project include the following:

- Pride: “No one can do it better than us.”
- Employee development: “This project can be used to train or develop an employee.”
- Cost savings: “Using internal resources will cost less.”
- Company politics: “The home office is here to help.”

After the skills and job requirements are identified, it is important to find the best talent to fill each position of the project team. This will require honest and frank assessments of the capabilities and experience of the utility and plant staffs. There should be no hesitation about interviewing people for key positions and making sure they are interested in the opportunity, are enthusiastic, and understand the task ahead. Any gaps in the project team members’ capabilities need to be identified up front—not later in the project.

It is not reasonable to expect that all of the necessary skills will be found in just one or two individuals. In addition, the skills required to execute the project will change as the project moves from contracting to manufacturing and to project completion. There must be continuity throughout the project to avoid duplication and errors of omission. This requires consistent project management and assembling the right people throughout the life of the project.

A list of required and desirable job skills, job descriptions, and position statements for each position can aid in identification of potential team members. Position statements should be developed as if an employee is being hired to fill the position. Is it full time? What key skills are needed? What experience is required? What is the duration of the assignment? How much travel is required? These are some of the questions that should be asked.

The skills list for each project will depend on the project size, complexity, corporate policies, vendor capabilities (original equipment manufacturer [OEM] or other) and other factors specific to the project scope. When selecting team members one should consider the attributes that apply to the procurement process and the quality of the supplied STG equipment, such as an individual’s experience with prospective suppliers and subcontractors, technical understanding of the component function, experience on similar projects, and QA/QC experience.

The project manager must set the proper tone for the quality program, and the entire team must have the attitude stated above that “quality is not an option.” The project team must have a strategy for the management of the quality process and must drive quality in everything they do. This is why selection of the team members is important. If quality does not matter to them, then implementation will suffer.

A reputable QA department should be inspecting the work based on the criteria set out in the specification. The QA manager and the project manager must understand and support the required testing and inspections and audit the QA program. The project manager needs to know if the quality plan is working as intended. Periodic audits should be scheduled, and additional audits should be performed if required, based upon the results of the scheduled audits. The team must have the desire and the authority to implement corrective action.

3.2 Outsourcing

Both internal and external resources should be considered to ensure that the proper skills are available for the entire project. As utilities strive to reduce costs and staffing levels, it may be appropriate to outsource engineering, project management, or other key positions. Although it may be ideal to staff projects with personnel from the utility staff, this may not be possible or prudent due to resource or workload limitations [4].

Use of third-party services may be required by contract or government regulations in instances such as certification and performance testing. Additional benefits of third-party contractors can include the following:

- Multiple-project experience
 - Awareness of potential equipment issues and solutions that can prevent failure or delays
 - Knowledge of proven project execution processes
 - Familiarity with the selected vendors' equipment, processes, and personnel
- Cost savings
 - Awareness of potential equipment issues and solutions that can save money
 - Use of local personnel for expediting, inspection, and testing, which can reduce travel requirements and avoid schedule delays
- Technology expertise
 - Knowledge of unique fabrication or manufacturing processes
 - Metallurgy and welding expertise
 - Ability to utilize high-tech diagnostic tools
 - Familiarity with current and new technologies

Table 3-2 lists some of the areas where third-party services can supplement the owner's project team.

Table 3-2
Outsourcing considerations

Staffing Area	Potential Project Activities
Project Management	Owner's representative Project management Scheduling Identification of qualified bidders Preparation of bid specifications Solicitation and evaluation of bids Support for contract negotiations Project reporting
Engineering and Technical Support	Design and drawing reviews Technical advice Project technical review Reliability and maintainability reviews Design oversight Manufacturing oversight Installation oversight Inspections, code compliance, and audits
Procurement	Shop visits Inspections Witness and hold points Shipping
Operations and Maintenance	Identification of additional craft requirements for outage and equipment installation Staffing level and skill reviews and recommendations Inventory and spare parts recommendations Identification and disposal of obsolete parts Procedure updates and revisions
Testing	Specialized testing—nondestructive evaluation (NDE), ultrasonic (UT), magnetic particle, and other Development, review, and management of test programs Performance and compliance testing and certification
Commissioning	Management of the commissioning and startup process Provision of key positions to supplement the owner's team Management of turnover packages
Training	Management and coordination of vendor training Supplemental training
Administrative	Records management Warranty management Claims and insurance investigations

3.3 Implementing QA/QC Throughout the Procurement Process

As stated previously, the project team is responsible for managing the cost, schedule, and quality of an STG component replacement project. EPRI report 1014717, *Project Management Guidance When Upgrading Steam Turbines at Nuclear and Fossil Power Plants* [1], provides guidance on implementing the entire project process, including management aspects and the process elements that should be included for procurement of major STG components.

Figure 3-1 depicts a logical sequence of events and the typical process that a project team might follow when considering the issues involved in procuring steam turbine components [1]. This process provides the team with adequate time to evaluate any issues and interface points among the various parties—owner, plant, supplier, installer, subcontractors, and third-party service providers. The figure also depicts the overall flow of information and the primary purpose of each element of the process, reflecting the fact that certain aspects of the design of the STG equipment involve an iterative process most effectively performed through close collaboration with the equipment designer/manufacturer.

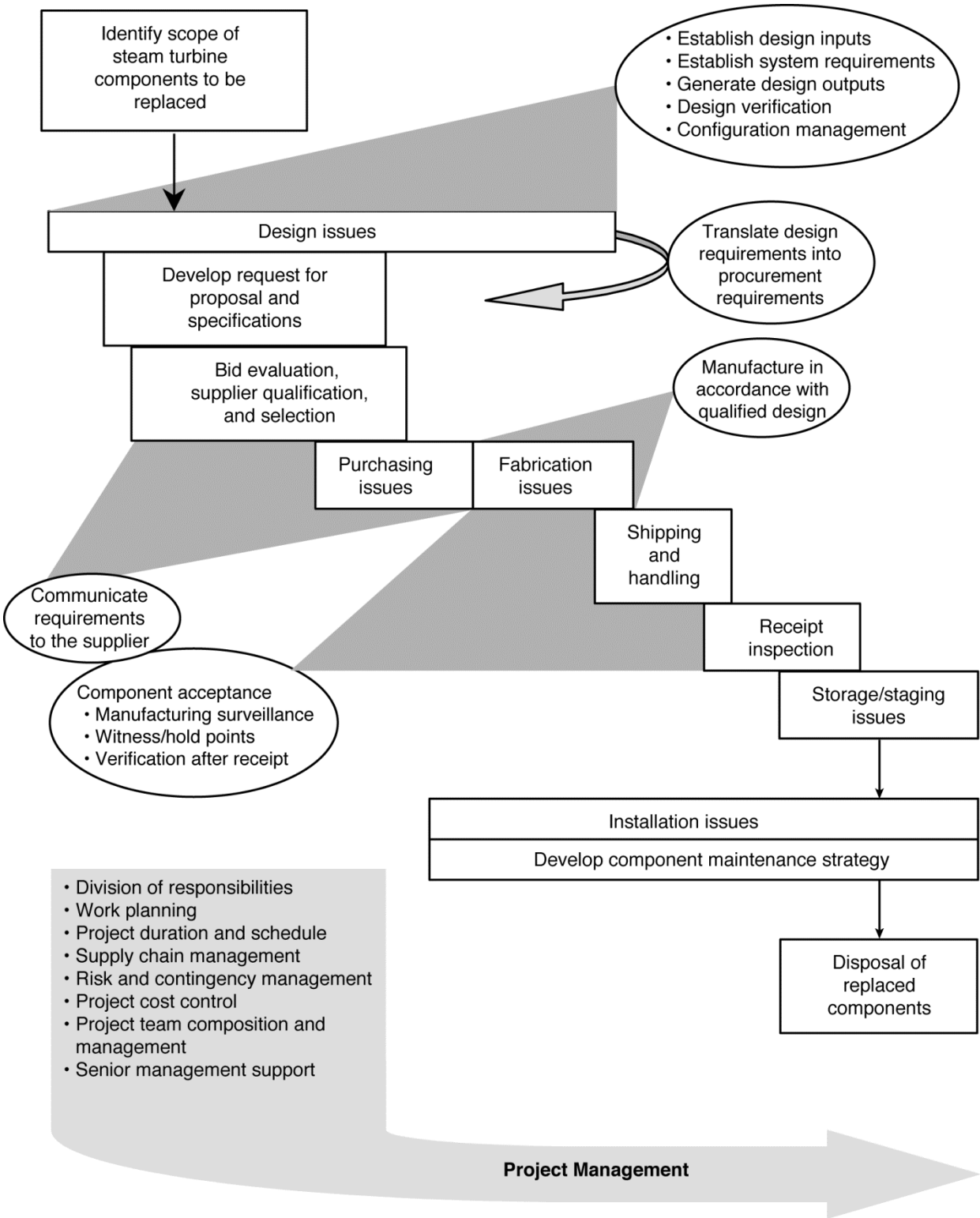


Figure 3-1
 Generic process for considering key issues when procuring STG equipment

The design of the STG equipment should also reflect consideration of plant operation and maintenance of the equipment, installation requirements, and impacts on other equipment.

3.3.1 Technical Information and Requirements

The technical specification provides the design requirements for the project. It forms the basis for soliciting bids and verifying that the bid offerings and the final product conform to the project requirements.

Finding all of the technical and design information may be difficult for older units, but a high level of effort is required. Bids should **not** be solicited before the necessary documentation is found and available. OEMs and potential bidders are good sources for information that may be missing from company and plant records.

3.3.2 Schedule and Budgeting

One of the keys to success when upgrading a major plant system such as the steam turbine or generator is the ability to manage the entire project to ensure that it remains on schedule, that it stays within the budget, and that the upgraded component remains suitable for its intended purpose and application. This involves the modification of various interface system components, each controlled with appropriate site-specific design change processes. Figure 3-1 also illustrates that project management entails many issues that are not necessarily directly related to the replacement component, such as the division of responsibilities and work planning [1].

Although each power producer's budgeting and approval processes will differ, a budget and schedule will be required for every project. The project team will provide periodic reports (generally monthly), each citing deviations from the schedule and budget. There should also be a section in each report that addresses the status of the procurement quality plan. The report should address any quality issues, potential project impacts, and solutions. The results of any audits and follow-up actions should also be documented.

The project scope, total duration, and milestones should be laid out so that all activities are planned and scheduled appropriately. The project manager should consider the following issues when establishing an overall project schedule for an STG component upgrade [1]:

- Pre-design activities: walkdowns, inspections of existing components, and conceptual design studies
- Pre-award activities: design engineering activities, specification development, and bid evaluation
- Manufacturing lead time: shipping duration
- Receiving and staging duration
- Demolition schedule

- Installation schedule
- Post-installation testing and startup activities
- Turnover activities
- Quality program audits

Once each of these major elements has been planned, the owner's work planning organization can typically be used to establish the overall project schedule and milestones in accordance with existing utility/site procedures [1].



Section 4: Bid and Contract Documents

When power producers are faced with replacing a major component due to wear and tear, obsolescence, age, or catastrophic failure, there is a need to ensure that the purchased replacement component meets all technical and operating requirements. Due to the critical nature of STG components in a generating facility and the impacts on cost, performance, and output, companies must take the appropriate steps in procuring the correct replacement component.

Today, power producers are faced with the fact that the replacement equipment may no longer be available from the original equipment manufacturer. OEM suppliers may have changed or gone out of business, or they may have merged with other companies. Often, new designs, materials, and manufacturing techniques have become available that can result in improvements in plant output and efficiency in comparison to the original equipment designs. New system operating parameters and grid requirements can also influence the purchase of replacement STG equipment.

Power producers today cannot simply rely on OEMs or other equipment suppliers to provide the appropriate replacement components and must therefore provide their own significant technical oversight and management of the procurement process.

4.1 Bid Document Preparation

A key initial step in this process is preparation of bid documents. The documents should identify the technical, quality, and commercial requirements as clearly as possible and contain a full set of instructions to the bidders, along with the specifications and contract terms. This establishes the technical and commercial framework for soliciting offers from qualified bidders and evaluating those bids.

Bid preparation is one of the most critical phases in procuring STG equipment. The project team must clearly identify all of the requirements and then prepare a bid specification, identify qualified bidders, and solicit bids.

EPRI report 1008256, *Plant Support Engineering: Guidelines for the Technical Evaluation of Replacement Items in Nuclear Power Plants*, identifies sources that may be used to prepare procurement documents [3]:

- Item function and functional classification
- Item failure modes and effects analysis (FMEA)
- Item critical characteristics for design determination
- Equivalency evaluation
- Original component specification
- Supplier manuals
- Seismic and environmental qualification reports
- Applicable Nuclear Regulatory Commission (NRC) Regulatory Guides (RGs)
- NRC Bulletins and Information Notices
- Purchase orders (previous)
- Applicable industry standards
- Supplier correspondence

4.2 Instructions to Bidders

The instructions to bidders provide a framework for the procurement process by giving information and guidance on the bid process, commercial terms, and schedule requirements. The bid instructions may include a draft contract (preferred).

At a minimum, instructions to the bidders should include the following:

- The format for the bidders' responses
- The bid due date
- Contacts and communications requirements
- Information regarding submittal of questions
- Site visit requirements
- Information regarding pre-bid meetings
- Specific documentation requirements
- Evaluation criteria (sometimes)

With regard to commercial issues, the contract terms may range from a complete draft contract (preferred) to a general listing of critical contract issues. At a minimum, the following commercial terms should be included:

- Schedule requirements
- Delivery requirements
- Liquidated damages
- Warranty
- Change control
- Documentation requirements
- Payment terms
- Bonus/penalty requirements (if any)

The commercial terms and the technical and quality requirements of the specification need to complement each other. It is important that the technical and quality requirements are clearly identified in measurable, quantifiable terms.

Liquidated damages should be a component of the bid and contract documents to compensate for any shortfall in equipment performance. These need to be clearly spelled out during the bid specification process. However, after installation this may be of little comfort to a plant manager who may be faced with a piece of equipment that does not perform as expected.

4.3 Specification

The establishment of proper technical specifications is a key element in the process for assuring that the procured components will perform their intended functions. The information developed in this activity is the foundation for subsequent activities in the procurement process and in establishing acceptance criteria. It is important that the technical and quality requirements of the specification are developed concurrently with the commercial terms.

There are three parts to the specification: the technical requirements, the quality requirements, and the supplier documentation requirements. These three parts of the specification form the framework for soliciting offers from bidders. As noted, these requirements need to be clearly identified in measurable, quantifiable terms.

4.3.1 Technical Requirements

Technical requirements describe the size, operating parameters, steam conditions, and other technical details related to the design, manufacture, and commissioning of the STG equipment specification. The technical description will define the following requirements:

- Equipment operating conditions—plant-specific normal and upset operating conditions
- Applicable codes and standards
- Environmental and seismic requirements
- Nuclear system and component safety classifications
- Requirements exceeding industry/code requirements
- Identification of interface points and work associated with connecting interfaces

4.3.2 Quality Requirements

Quality requirements provide a means for assuring that the specification is fully met and all deviations and other issues are identified in a timely manner. They specify the quality requirements of the supplier during the manufacturing, design, delivery, installation, and testing phases of the project. The specification should also define the responsibilities of the project team and other organizations included in the power producer's QA program.

Quality requirements are not a substitute for the technical requirements of the bid specification. The technical requirements provide the details on what is being procured, whereas the quality requirements provide the details of how it is to be built, delivered, and installed and how it needs to perform in order to serve the intended use.

For example, a technical specification for a car might specify the engine size, the number of doors, the paint color, and the type of tires. The quality requirements will specify the materials of construction, manufacturing tolerances, wear requirements, and testing requirements. A supplier could provide a car that conforms to the technical specification, but without the quality requirements the car could still have an old, worn-out motor, chipped paint, ill-fitting doors, and tires that will only last 10,000 miles. Both the technical and quality parts of the specification are needed to make sure that the equipment will meet the intended purpose.

Owners will want specific quality requirements, and the suppliers will need this information to prepare an accurate technical and commercial offering. The problems arise when they have different **interpretation** of the specification's requirements. There are many terms that are routinely used within the utility industry that do not belong in a specification, such as the following:

- First-class
- No visible defects
- Highest grade
- Best practices
- Utility grade

These descriptors all **sound** good, but they are not quantifiable or enforceable. The problem with the use of superlative or ambiguous language is that the owner is left with an unenforceable specification. The words used in specifications have a direct effect the supplier's perceived requirements and therefore on the supplier's ability to deliver the product in a timely fashion.

The following examples demonstrate some of the issues that can result from simply choosing the wrong words in a specification.

Example 1: "First-Class"

Suppose the specification states that the engineering design for a car must be "first-class." What is first-class? Presumably it implies a quality level associated with a luxury vehicle such as a Cadillac or a Rolls-Royce. Both are considered luxury vehicles, and could be both considered first-class. If your specification was for a "first-class" vehicle, what would you expect and what would the supplier think you wanted? Perhaps more importantly, what would they bid on and supply? Obviously, such a term has no place in a specification.

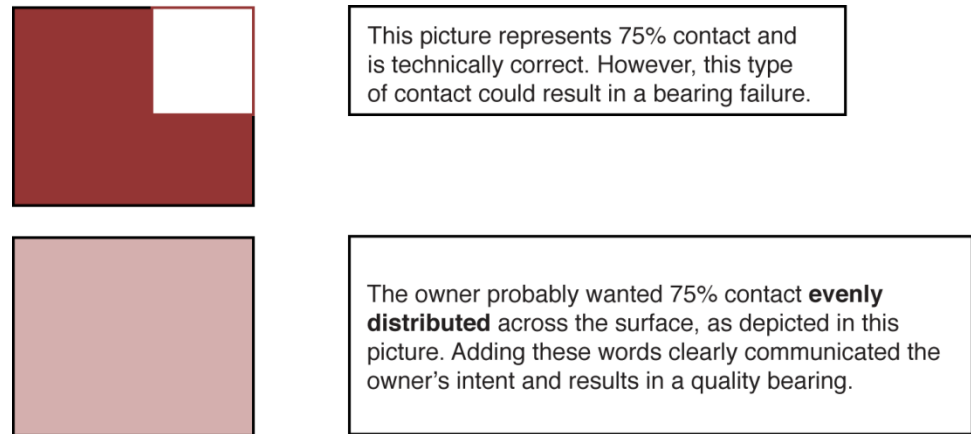
Example 2: "No Visible Defects"

Suppose a specification states that equipment should have "no visible defects." This requirement depends on the visual acuity of the person verifying the criteria and cannot be clearly measured. For example, from a distance of 1000 feet (305 meters) it is difficult to see any defect, whereas an electron microscope can "see" defects on the atomic scale. It is much better to define what defects are of concern and how they will be measured (for example, by including acceptance criteria for post-installation steam blows).

There are other words and phrases that may seem fine but can have unforeseen results. For example, consider a specification for a bearing with the following wording:

Blue-check and scrape insulated bearing seats to bearings to achieve 75% contact, with 100% contact around the oil hole.

Although the requirement for 100% contact around the oil hole would seem to provide the proper bearing contact, it is possible that this specification could still result in a bearing that could fail in service. What does 75% contact **mean**? Figure 4-1 depicts two possible outcomes for this requirement in the specification.



*Figure 4-1
Two interpretations of 75% contact*

In some cases, the specification may drive up the project cost or deter some suppliers from even participating in the bid process. The owner must ensure that the specifications are truly required, while allowing bidders to offer new technologies that may improve the equipment. This balance can be achieved by discussing the different technologies with vendors in advance of issuing the proposal.

In order for suppliers to compete equally, the words used in the specification must define the true qualities that the owner requires. The specification must be clear and provide measurable criteria that the supplier can meet and the owner can verify. Otherwise the quality program will have nothing to measure the equipment against and the procurement process is destined to fail. Disagreements are not easily resolved in a timely manner.

The quality requirements specified on the procurement document typically include QA program requirements such as the following [3]:

- ANSI N45.2, “Quality Assurance Program Requirements for Nuclear Power Plants.”
- 10CFR50 Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Processing Plants.”
- American Society of Mechanical Engineers (ASME) Section III, NCA 3800, “Metallic Material Organization’s Quality System Program,” Evaluation Process for Replacement Items.
- ANSI/ASME NQA-1, “Quality Assurance Program Requirements for Nuclear Facilities.”

- ISO-900 1, “Quality Management Systems—Requirements.”
- IEEE-467, “Quality Assurance Program Requirements for the Design and Manufacture of Class 1E Instrumentation and Electric Equipment for Nuclear Power Generating Stations.”
- Licensee QA program manuals.
- Suppliers approved commercial quality program manuals—listings of specific QA program requirements.

Source inspections (including witness and hold points) should be specified for manufacturing processes affecting the critical characteristic for design for which the quality cannot be confirmed by other available methods. (For guidance on the other methods available, see EPRI report NP-5652 [5] and ANSI N45.2.13, “Quality Assurance Requirements for the Control of Procurement of Items and Services for Nuclear Power Plants” [6].)

Special quality requirements should be tailored to the critical characteristic for design, such as the performance of tests and inspections by the supplier. For example, dye penetration testing may be required to verify weld quality, or a performance test may be required to verify the head and capacity of a pump. Special quality requirements can be imposed on a commercial supplier because these types of requirements are used in many non-nuclear applications.

Quality requirements to be included in the specification should include the following [4]:

- Specific requirements of the quality assurance program.
- Type and frequency of supplier audits.
- Material specifications.
- Receiving inspections.
- Quality assurance program requirements. Identify any special regulatory or other requirements that the supplier quality program must meet, such as nuclear safety applications or ISO 9000 certification.
- Frequency and types of supplier audits. The quality plan must be audited. The project team needs to know if the quality plan is working as intended. Periodic audits should be scheduled. Additional audits should be performed if indicated, based on the results of the scheduled audits. Provide requirements for any performance-based audits/commercial-grade surveys. A reputable QA department should inspect the work, based on the criteria set out in the specification.
- Witness and hold points. Identify requirements for owner inspection or witnessing of tests or manufacturing steps. They should focus on items that are critical to the design and manufacture of the equipment. Proper witness and hold points are effective in reducing rework and managing costs. Source verifications (including witness and hold points) should be noted.

- Transportation and receiving inspections. Identify the verification requirements in preparation for and during shipping. Identify requirements for shock, vibration, or environmental monitoring during shipment and for tracking via global position monitoring.
- Installation. Identify any installation requirements
- Commissioning and operation (performance requirements and testing requirements and acceptance criteria). Identify any required tests and the testing protocol, as well as the consequences of failing a test.
- Other special quality requirements, which may include any of the following:
 - Qualification testing, including mockup access requirements for inspection/audit/surveillance.
 - Defect reporting according to 10CFR21 for nuclear suppliers.
 - Dedication methodology according to EPRI NP-5652.
 - Performance of sub-supplier's inspection/audit/surveillance/sampling according to established procedures or recognized standards.
 - Special processes and/or cleanliness requirements.
 - Field verification, by the STG vendor, of all interface points.
 - Access requirements for inspection/audit/surveillance.
 - Performance reporting, corrective actions, and continued diligent follow-up. (Extended warranties, spare parts, discounts, liquidated damages, and bonus/penalty arrangements may be utilized to influence supplier behavior.)

By developing defined specifications, documentation, and a rigorous surveillance program as part of the procurement process, the owner can validate the suppliers' quality programs, ensuring delivery of specified components that meet operating requirements. The quality requirements provide a means for assuring that the specification is fully met and deviations and other issues are identified and corrected in a timely manner.

Suppliers, subcontractors, installers, and other third-party companies should be fully engaged when developing and managing the quality plan. Meetings, shop inspections, and hold points should be discussed and agreed upon. It is essential that the project quality requirements be passed on to a supplier's subcontractors. The bid documents should require the bidder to identify potential subcontractors, and their contract documents must require all subcontractors to meet the same quality standards as the prime contractor. The prime contractor should be contractually responsible for their subcontractors.

For more detailed guidance on developing the specification, refer to EPRI report 1022321, *Guidelines for Reducing the Time and Cost of Turbine-Generator Maintenance Overhauls and Inspections, Volume 4: Turbine-Generator Component Procurement Specifications* [2].

4.3.3 Supplier Documentation Requirements

Supplier documentation required as objective evidence that the technical and quality requirements of items have been met should be specified in the bid process. Supplier documentation may also be specified to provide confirmation of equivalency for an alternate replacement item or to identify discrete differences to facilitate the evaluation of an alternate item by the licensee. Documentation should be considered a tool in the verification of an item's technical adequacy and quality compliance but should not be used without confirmation of its validity.

Supplier documentation requirements should correlate with the specified technical and quality requirements and be specific as to their content. Care should be taken not to request excessive or meaningless documents such as invalidated certificates of conformance or test reports that are not applicable to the item [3].

Certificates of conformance should avoid generalized statements such as "This item meets the requirements of the purchase document." Rather, they should contain specific statements, such as "These items were sample tested in accordance with MIL-STD-105E and verified to meet the tensile strength requirements of ASME SA 193 Grade B7. Test results are available for review." [3]

The types of supplier documentation typically specified should include the following, as applicable:

- Supplier drawings, procedures, and specifications
- Supplier instruction manuals
- Qualification reports
- Certified material test reports
- Nondestructive test reports
- Personnel certifications
- Inspection reports
- QA manuals
- Validated performance test reports
- Validated certificates of conformance/compliance

Supplier retention time of records should also be specified. The quality and legibility of the records should be specified, where necessary, to ensure future reproduction capability [3].

See the following publications for additional details on documentation requirements:

- EPRI NP-5652 [5]
- ANSI N45.2.13 [6]
- ANSI N45.2.2 [7]

4.4 Qualifying Bidders

There are a limited number of potential bidders who can supply major STG equipment and components. It is, however, still important to qualify all potential bidders along with their quality programs. Power producers typically want to obtain enough bids to ensure competition while still maintaining control of the process.

Identification of qualified bidders should be based upon their ability to provide items in accordance with the procurement document requirements (see ANSI N45.2.13 Section 4 [6]). There are many issues to be considered when developing a list of qualified bidders. Identification and evaluation of potential suppliers and vendors requires a significant amount of due diligence and needs to evaluate each vendor's technical and manufacturing capability, quality program, contract performance, and financial strength. The evaluation process for vendor selection should be documented and should include an evaluation of past performance and current and future capabilities as appropriate for each situation [4].

A more detailed description of the vendor selection process can be found in EPRI report 1014717, *Project Management Guidance When Upgrading Steam Turbine at Nuclear and Fossil Power Plants* [1].

4.4.1 Evaluating Past Performance

Evaluation of a supplier's past performance will identify potential issues that can adversely impact the overall success of a retrofit or replacement. In qualifying potential suppliers, the project team should determine the supplier's ability to deliver equipment that meets the performance and technical requirements [4].

Past performance is even more critical for third-party (non-OEM) suppliers. Even if the third-party supplier is a relatively new supplier for the equipment being procured, history on other projects and equipment will often provide insight to the supplier's capabilities. The following questions can be helpful [4]:

- Has the supplier provided similar equipment before?
 - Determine where and when installation was done.
- What kind of experiences have others had with the supplier?
 - Obtain contacts and references, and follow up on them.

- Has equipment performed as designed?
 - Identify any technical issues and resolutions.
 - Identify any performance issues.
 - Identify any maintenance issues.
- Were there any issues with labor or manufacturing?
- Did the supplier provide competent field, training, and technical support?
- Were there any significant contract compliance issues?
 - Confirm that documentation was accurate and in compliance with specifications.
 - Identify any unusual contract requirements.
 - Identify any deviations from schedule and deliverable commitments.
 - Review liquidated damages and warranty.
 - Identify any contract issues that required arbitration or legal action.
- What was the general working relationship with the supplier?
 - Adversarial
 - Open and forthcoming
 - Secretive
 - Strictly contractual

4.4.2 Determining Current and Future Capabilities

Shop loading, technical resources, and financial strength must be verified to ensure that the supplier will be able to meet current and future commitments, as summarized below [4]:

- Verify that current quality records meet company and industry standards.
- Review implementation of the supplier's QA program. If the replacement component is being procured from a new supplier, an initial qualification evaluation (for example, an audit or commercial-grade survey) can be performed.
- Verify that the supplier has the necessary technical and quality capabilities to support the project.
 - Visit facilities and meet with personnel.
 - Verify the quality and technical capabilities of outsourced technical and design service suppliers.
- Verify manufacturing capability.
 - Shop space.
 - Labor situation—if union, is the contract open for negotiations during the manufacture of equipment?
 - Shop organization and cleanliness.
 - Safety record.
 - Manufacturing lead time.
 - Quality and manufacturing capabilities of materials and equipment suppliers.

- Verify that the supplier has the financial strength to execute the work.
 - Bonding capabilities.
 - Financial information—revenue projections, working capital, stock value, and outstanding debt.
 - Work backlog.
 - Any significant current or future litigation that could impact the financial situation.

More detailed information on bidder qualifications can be found in EPRI report 1014717 [1]. Section 5.1 of that report provides guidance on supplier selection and qualification.

ANSI N45.2.13 Section 4 states in general that the selection of suppliers should be based on evaluation of their capability to provide items in accordance with the requirements of the procurement documents. The standard also requires that procurement source evaluation and selection measures include integrated actions involving one or more organizations (for example, engineering, construction, manufacturing, operations, maintenance, purchasing, or QA), based upon the item being procured [6].

The evaluation of suppliers' QA programs should be documented and should address the following questions:

- Have previous STG components performed as expected? If not, what issues have surfaced and what has the supplier done to address them?
- Is the supplier's quality plan current, documented, and effective?
- How is the quality plan implemented?
- Does the supplier have adequate technical resources to implement and monitor quality requirements?
- How are the supplier's quality requirements passed to its subcontractors? Are there any subcontractor quality issues? Does the supplier maintain a list of approved subcontractors?
- Does the supplier audit its quality program? What are the results of audits and what actions have been taken to address them?

The project quality manager must invest time and effort to understand suppliers' quality programs, with particular attention to subtier vendor management and control.

The owner's and contractor's teams must work together to identify and define common and reasonable expectations. Processes should be designed to be efficient, reliable, and effective. Except with regard to proprietary information, the QA program must be transparent. Well-designed QA programs do not interfere with or impede the execution of the work by imposing unnecessary bureaucracy.

4.4.3 Preparing for the Unknown

In spite of best efforts, things can go wrong in the procurement process. Mother Nature can wreak havoc on manufacturing facilities and delivery plans. The direct damages from hurricanes, typhoons, tornadoes, earthquakes, floods, and fires are obvious. However there may also be secondary impacts. For example, Japan had rolling blackouts and brownouts after a typhoon, and civil unrest and demonstrations can affect delivery routes.

Here are some suggestions for preparing for the unknown:

- The power producer should identify any concerns in the bid documents and should consider adding contingency to the project based upon discussions with the bidders and their own assessment of the risks.
- In order to try to mitigate potential project impacts, bidders should identify potential emergencies that may impact the design, manufacture, and delivery of the equipment.
 - Potential solutions such as an alternate manufacturing facility and alternate subcontractors should be identified.
 - Potential location- and country-specific problems should be identified and a plan developed for how to mitigate them.
- Both parties may wish to develop a QA/QC flow chart to identify and manage contingencies.

4.5 Bid Evaluation

The bid evaluation process must meet the company procurement requirements and ensure a thorough assessment of the commercial and technical aspects of the bid. Section 2 of ANSI N45.2.13 requires that the plant licensee establish measures for the control of the procurement of a replacement component, including appropriate planning [6].

Proper planning is required to ensure that the methods to be used in procurement activities are properly documented. To support this, applicable procedures should exist prior to the initiation of each activity, there should be an established sequence of events with milestones, and a process should exist to track progress [4].

Another factor that should be considered that is not explicitly described in ANSI N45.2.13 is the division of QA programmatic responsibilities between the project team and various organizations in the supply chain.

Section 5 of ANSI N45.2.13 states, in general, that a licensee should establish a documented system for reviewing and evaluating bids and awarding contracts [6]. This established process should be used for the evaluation of bids for replacement components. The general bid evaluation process used by many utilities is illustrated in Figure 4-2 [1]. Bids are typically received by the company procurement organization, and the appropriate portions of the bid are provided

to the individuals on the project team or company organizations for evaluation of various components of the bid in relation to the bid specification. The technical and commercial evaluations are performed separately and then combined to develop an overall evaluation and recommendation [4].

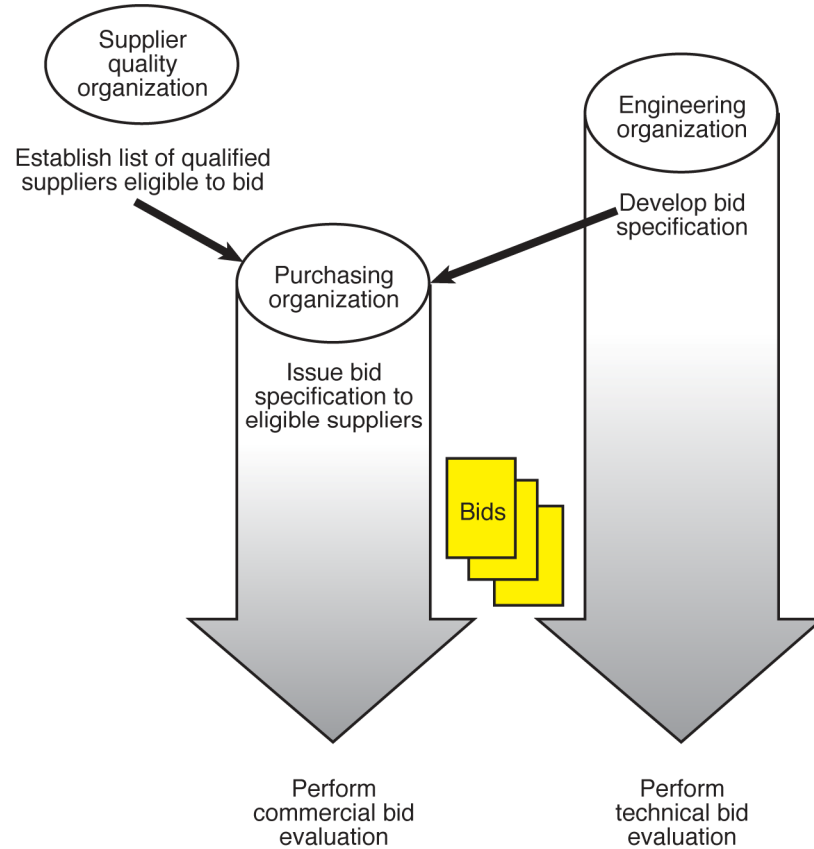


Figure 4-2
Supplier selection and bid evaluation

Bid evaluations should be made by individuals or organizations designated to evaluate the following subjects, as applicable to the type of procurement and replacement component:

- Technical considerations
- Quality assurance requirements
- Supplier's personnel
- Supplier's production capability
- Supplier's past performance
- Alternate designs for consideration
- Evaluations of exceptions to the bid
- Schedule adherence

Other factors, although not quality related, that should be considered may include any of the following:

- Warranties
- Equipment purchase price and price adjustments
- Supplier experience/reputation/recognition in the nuclear industry
- Manufacturing facility location
- Ease of doing business
- Commercial terms and conditions

4.5.1 Commercial Terms

The negotiation of commercial terms and conditions is typically not within the scope of either the design engineering or procurement engineering organizations. Therefore, the purchasing organization should take the lead role in resolving these types of issues. Special commercial considerations may include the following:

- Delivery, title, and risk of loss
- Warranty duration and limitations
- Limitations of liability
- Liquidated damages
- Indemnity
- Insurance
- Nuclear financial protection
- Transferring, shipping, and routing of equipment
- Transfer of responsibility during shipment, receipt, storage, staging, and installation
- Type, schedule, and frequency of document reviews
- Quantified level of oversight by the project team
- Government regulations



Section 5: Design, Manufacturing, and Installation Oversight

After the contracts are signed, the real work of designing and manufacturing the equipment begins. This is the time to review the bid specification documents along with the rights and obligations of both the owner and contractor.

Before design and manufacturing begin, the project team should conduct the first review meeting (the kick-off meeting) with the successful bidder. The purpose of this meeting is to review the specification and the contract, establish the roles of the project team, confirm communications, and identify each group's decision makers.

Identification of the decision makers is critical. The decision makers on each company's team must be identified so critical decisions are not delayed or overlooked. The final decision on engineering, alignment, shipping methods, alignment procedures, testing regimens, and similar items can not only delay the project, but can also impact the performance, operability, and maintainability of the equipment.

Project management oversight becomes the key component of the project at this point. Oversight is necessary to ensure that the replacement STG equipment will meet its intended function and use. In order to maintain the quality of the major STG component during the design, manufacturing, and installation process, the project team must have a robust oversight program. This program should consist of scheduled review meetings, shop inspections, and hold points.

Diligent oversight of the contractor by the owner provides the following:

- Proper management and control of the project
- Risk mitigation
- Support for meeting government, company, and other jurisdictional requirements
- Confirmation that the requirements of the specification have been met

- Assurance of compliance with the specification
- Assurance that the project team—both the owner and the contractors—has a clear understanding of the contractual obligations
- An early warning system to identify potential issues so they can be addressed in a timely manner

Misunderstandings, lack of knowledge, and failure to coordinate with each other can result in design or manufacturing flaws that could lead to significant time delays, cost increases, performance degradation, and in the worst cases, equipment that does not meet the requirements of the specification.

5.1 Review Meetings

Review meetings should be scheduled to occur at periodic intervals and at other key times, as noted below, during the design and manufacturing phase of the project. In most cases, review meetings should be held at the contractor's place of business and the design and fabrication facilities.

In order to be effective, design reviews need to be scheduled so as to allow changes in the equipment design, manufacture, testing, schedule, shipping, and so on. The required timing and participants should be incorporated into the vendor's contract. Typical review points are as follows [4]:

- During the design phase
 - Conceptual design
 - Final design
- Prior to the start of manufacturing
- Prior to shipping
- Prior to installation
- Prior to final acceptance
- After final acceptance

Review points should be adjusted by the project team based upon the complexity of the project, the experience with the equipment supplier, and the results of previous reviews.

Each project is somewhat unique; therefore, the agenda should be modified to meet the requirements of the project. In general, meetings should address the following areas:

- Safety
- Quality
- Project scope and changes
- Technical/design
- Manufacturing

- Installation
- Commissioning and testing
- Schedule
- Staffing
- Contract

Design reviews provide the project team with the opportunity to verify design information, testing plans and results, drawings, manuals, and so on. The parties should ensure that all information is consistent with the requirements of the specification. The following are tasks that participants typically should perform:

- Provide for owner review and acceptance of project documentation
 - Drawing reviews
 - As-built drawings
 - O&M manuals and procedures
 - Project reports
- Review supplier's inspection and testing plans
- Review material test reports and other information provided by the supplier's subcontractors
- Review the schedule to verify progress, and expedite commitments to identify any potential issues that may impact the return to service date or other planned work at the site
- Review the process to verify that the quality program is being properly implemented
- Document any non-conformance to the technical specification and the quality plan so that it can be addressed in a timely manner
- Disclose failure investigations, ad hoc reviews, and solution advice regarding any product or process problems

Some areas of concern to watch for are the following:

- Changes in materials and in material sourcing
- Changes in the manufacturing process and manufacturing location
- Supposed improvements in the design
- Changes in key staff and the organization
- Changes in testing and acceptance criteria
- Changes in the schedule
- Changes in the supplier's company financial condition
- Changes in supplier's subcontractors

5.2 Inspections and Hold Points

After release for manufacturing, the project team must implement and adhere to a surveillance program that includes shop inspections, witness points, and hold points. Inspections should be scheduled at or prior to key events in the manufacturing process such as welding, fabrication, assembly, machining, and testing.

Key elements of the surveillance program should include reviews of supplier and subcontractor data, inspections, and hold points.

5.2.1 Inspections and Walk-Throughs

Inspections and walk-throughs provide opportunities for visual inspection of the design and manufacturing process. Each inspection and/or walk-through should be done with formal documentation such as with an inspection sheet to verify that the correct information is reviewed and recorded. If deemed necessary, corrections are applied to the appropriate project process. Equally as important as the inspection criteria is the qualification of the person or team performing the inspections and walk-throughs. This is an area where third-party experts can often provide value.

The following areas are typically covered during inspections of the equipment at specific stages of production and witness of testing:

- Metallurgical investigations, particularly in relation to welding or nondestructive testing problems
- Bending, heat treatment, and surface hardening procedures
- Welding procedures and welder qualifications
- Review and endorsement of project documentation
- NDE procedures
- Inspection of packing, loading, unloading, and shipping plans prior to shipping and upon receipt at the facility
- Authorization of inspections by third parties

5.2.2 Hold Points

Hold points are designated to allow the owner to verify design and manufacturing compliance with the specification, to allow for finalization of the design, and to provide the contactor with confirmation of the owner's requirements, prior to resumption of design and manufacturing. The selection of hold points should be agreed upon by the owner and the contractor during the bid process and included in the contract.

Typical hold points are listed below; however, each project should be evaluated to ensure that the proper hold points are included. Too many hold points can delay a project, while too few hold points can result in equipment that does not meet the requirements of the specification. An insufficient number of hold points can also lead to rework, schedule impacts, and cost increases.

Examples of potential hold points include the following:

- Prior to release for manufacturing
- Whenever there is a change in materials or place of manufacture
- Key points during assembly
- Upon major component machining or welding
- Prior to closing up an area
- Key points during balancing
- Prior to packaging and shipping
- Prior to the start of installation
- Key points during installation
- Prior to lifting and setting of the rotor
- Key points during alignment
- Key points during final assembly
- Prior to placement on the turning gear
- Prior to steam admission
- Prior to energizing the generator field
- When excessive vibration occurs
- Prior to connecting to the grid
- Key points during acceptance testing



Section 6: References

1. *Project Management Guidance When Upgrading Steam Turbines at Nuclear and Fossil Power Plants*. EPRI, Palo Alto, CA: 2007. 1014717.
2. *Guidelines for Reducing the Time and Cost of Turbine-Generator Maintenance Overhauls and Inspections, Volume 4: Turbine-Generator Component Procurement Specifications*. EPRI, Palo Alto, CA: 2010. 1022321.
3. *Plant Support Engineering: Guidelines for the Technical Evaluation of Replacement Items in Nuclear Power Plants—Revision 1*. EPRI, Palo Alto, CA: 2006. 1008256.
4. *Large Steam Turbine Component Retrofits and Replacements: Lessons Learned*. EPRI, Palo Alto, CA: 2010. 1019648.
5. *Guideline for the Utilization of Commercial-Grade Items in Nuclear Safety-Related Applications*. EPRI, Palo Alto, CA: 1988. NP-5652.
6. *Quality Assurance Requirements for Control of Procurement of Items and Services for Nuclear Power Plants*. American National Standards Institute, Washington, DC. ANSI N45.2.13.
7. *Packaging, Shipping, Receiving, Storage, and Handling of Items for Nuclear Power Plants During the Construction Phase*. American National Standards Institute, Washington, DC. ANSI N45.2.2.

Export Control Restrictions

Access to and use of EPRI Intellectual Property is granted with the specific understanding and requirement that responsibility for ensuring full compliance with all applicable U.S. and foreign export laws and regulations is being undertaken by you and your company. This includes an obligation to ensure that any individual receiving access hereunder who is not a U.S. citizen or permanent U.S. resident is permitted access under applicable U.S. and foreign export laws and regulations. In the event you are uncertain whether you or your company may lawfully obtain access to this EPRI Intellectual Property, you acknowledge that it is your obligation to consult with your company's legal counsel to determine whether this access is lawful. Although EPRI may make available on a case-by-case basis an informal assessment of the applicable U.S. export classification for specific EPRI Intellectual Property, you and your company acknowledge that this assessment is solely for informational purposes and not for reliance purposes. You and your company acknowledge that it is still the obligation of you and your company to make your own assessment of the applicable U.S. export classification and ensure compliance accordingly. You and your company understand and acknowledge your obligations to make a prompt report to EPRI and the appropriate authorities regarding any access to or use of EPRI Intellectual Property hereunder that may be in violation of applicable U.S. or foreign export laws or regulations.

The Electric Power Research Institute Inc., (EPRI, www.epri.com) conducts research and development relating to the generation, delivery and use of electricity for the benefit of the public. An independent, nonprofit organization, EPRI brings together its scientists and engineers as well as experts from academia and industry to help address challenges in electricity, including reliability, efficiency, health, safety and the environment. EPRI also provides technology, policy and economic analyses to drive long-range research and development planning, and supports research in emerging technologies. EPRI's members represent more than 90 percent of the electricity generated and delivered in the United States, and international participation extends to 40 countries. EPRI's principal offices and laboratories are located in Palo Alto, Calif.; Charlotte, N.C.; Knoxville, Tenn.; and Lenox, Mass.

Together...Shaping the Future of Electricity

Program:

Steam Turbines-Generators and Auxiliary Systems

© 2012 Electric Power Research Institute (EPRI), Inc. All rights reserved. Electric Power Research Institute, EPRI, and TOGETHER...SHAPING THE FUTURE OF ELECTRICITY are registered service marks of the Electric Power Research Institute, Inc.

1024903