

Design/Build Cleanroom Specifications and Proposals

Guidelines on writing specifications and evaluating proposals

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Abstract

When using the design/build method of delivery for a cleanroom project, proper creation of the project specification is critical. The contractor must then present a proposal in a manner by which the owner can accurately assess the value they are receiving. The intent of this document is to provide a guideline for developing an effective specification and evaluating proposals for cleanroom projects.

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Introduction

When using the design/build method of delivery for a cleanroom project, proper creation of the project specification is critical. The contractor must then present a proposal in a manner by which the owner can accurately assess the value they are receiving. The intent of this document is to provide a guideline for developing an effective specification and evaluating proposals for cleanroom projects.

Specifications that Enable Flexibility

A planner is sometimes used to detail the parameters of a specification. Unfortunately, planners are often clouded with too much inappropriate detail. This can cause the design to be framed in a way that does not allow the contractor the flexibility to utilize their experience and expertise to propose the best solution. For example, if the owner has a preconceived notion as to the preferred type and finish of the wall or ceiling system, it precludes the contractor from submitting information on more appropriate or less expensive products to fit the need.

Basic Specification Items

All specifications should include the following basic items:

General Overview

The specification should begin with the general overview of the facility and proposal requirements. It is important that the overview include the type of work which will be performed within the facility and any production.

Production facilities that operate 24 hours per day should not be designed the same as R&D facilities, which are utilized intermittently and never for more than 8 hours at a time.

Scope of Work

The scope of work that will be required from the contractor must be clearly defined. Will the

scope include the cleanroom design and construction only? Will the contractor need to incorporate requirements (such as electrical, exhaust and process gases) for process equipment? Will internal facilities personnel deliver services to a point of connection, or will the contractor be required to search out and determine the points of connection? In many cases, these items will depend upon the depth and workload of your internal staff as well as your individual facilities department regulations.

Completion Date

A required room completion date should be included. If the schedule is flexible, let that be known and negotiate a schedule at contract time. Putting a false schedule on a project may have price implications, which may not surface in the evaluation process.

Taxable Status, Permits

The taxable status of the project as it can impact price, so it is important to clearly your corporation's tax position on the project. In addition, the specification should note what should or should not include in the proposal. For example, permits, stamps, and fees pose significant hidden costs in any construction project. Be clear to the design/builder what your organization's intent is. If you require local permitting, the process will undoubtedly add time to your schedule and cost to your project.

The division of responsibility and the posture with local code officials should be a fluid process with your design/builder. Permit time and fees can vary based on the local building officials' familiarity with your company or the design/build firm. How the cleanroom is classified by your organization (modular cleanrooms frequently are classified as capital equipment versus leasehold improvement) also affects permits and fees.

At a minimum, insist that the design/builder include the cost to stamp the drawings and acquire the permits. It will typically be in both parties' best interest for fees be a negotiated pass-through cost. The contractor or your in-house facilities department should be able to

estimate permit fees to include in your capital appropriations.

Key Design Information

All specifications should include the items included in this section. If you cannot provide a significant portion of the items listed or at least reasonable assumptions regarding these items, the design/build method of delivery may not be the most appropriate method for your needs. At a minimum, you may need to solicit assistance in determining those requirements prior to soliciting proposals. Allowing for too many assumptions to be made by the design/build contractors will make your task of evaluating proposals nearly impossible.

Architectural

In order for it to accurately assess the architectural construction requirements logistically, the owner should specify:

- Basic cleanroom floor plan
- Equipment plan
- Facility plan

In the absence of the availability of these items, the request for proposal should require a site survey to determine the issues impacting cleanroom design and construction, such as location of the cleanroom within the facility, possible location of support equipment for the cleanroom, equipment and material entry path, etc.

Minimal architectural parameters include:

- Required room classification (or the particle size to be eliminated from the environment)
- Square footage of clean space and support space
- Ceiling height, clear ceiling height of the existing space
- Floor of the building the room will go on
- Pertinent seismic or structural issues

The accuracy of the logistical information supplied is directly proportional to the accuracy of the contractor's proposal.

Mechanical

The mechanical section of the specification is invariably the portion that can differ greatly from concept-to-concept. This section is where the most effort should be directed in assessing and writing the requirements. First and foremost, determine if the driving force of your requirements centers on precise temperature control or precise humidity control. Improper understanding of temperature and humidity and how they are affected by the process within the cleanroom; how they affect each other and equipment requirements and sizing, and how HVAC equipment is controlled, are without doubt the biggest issues in cleanroom design. The temperature and humidity control set points required are sometimes not as instrumental as the control bandwidth (the plus or minus variables). Comfort cooling for cleanrooms is widely accepted to be 68 degrees F; the most widely accepted humidity control point is 45%.

Temperature Set Point

Temperature set point should be determined somewhat by the cleanroom classification, or more accurately by the garment requirements of the cleanroom classification. Garments utilized in more stringent cleanrooms are designed to encapsulate the worker and eliminate particle escape. This process in turn reduces the ability of the worker's body to breathe and expound heat; therefore, the surrounding environment should take this into account. If precise temperature control is not a requirement of the process, the control bandwidth should be +/- 3 degrees, allowing for economical (industrial type) equipment, controls, and valves.

Humidity

Humidity and its relationship to temperature is the single most costly and misunderstood factor in cleanroom design. "Relative Humidity" is just that: relative to the temperature it is measured at. If your process dictates that optimum performance is at 70 degrees F and 45% RH, that is not the same operating condition (i.e. moisture content) as 68 degrees F and 45% RH. To achieve the same grains of moisture (the

amount of moisture in the air) at 70 degrees F and 68 degrees F, the corresponding relative humidity to 45% would be approximately 40%. This could be a significant delta in microelectronics applications. It is the reason that a 68-degree rainy summer day feels much cooler than a 68 degree dry fall day.

The moral of the story is: that determining the process temperature and humidity requirements of the cleanroom is of utmost importance; and, if not accurately determined; it could significantly affect your process, therefore rendering the cleanroom improper for your needs. Be aware also that setting a cleanroom parameter that controls temperature and humidity more precisely than is required, or with added range to allow for flexibility, is significantly more expensive, and vice versa.

Other Mechanical Parameters

In addition to temperature and humidity parameters, other parameters that impact the cleanroom's HVAC systems must be detailed. Some of these items include:

- Heat load of the equipment to be utilized within the room is significantly important.
- A tool matrix, or cut sheets on the equipment to be installed, will help insure the assumptions made by the design/builder are correct.
- The number of people assumed to be working in the room also is significant. People add active (heat generation) and latent (moisture generation) load to a cleanroom system.
- Exhaust requirements (if any) of the room are important to determine make-up air for the facility (again, here is where the tool matrix or cut sheets come in handy) as well as where the make-up air will be drawn from (the facility or directly outside).
- The temperature of the surrounding area that the cleanroom will be installed within also affects cooling requirements, due to heat transference.

Sprinkler System

The requirements of the sprinkler system for the cleanroom are dependent upon the occupancy

code and use, as well as local building codes. Some jurisdictions require sprinklers within plenums, on mezzanines, in the space, and under raised floors. This effectively requires 4 levels of sprinkler coverage.

The present facility system may be at capacity for the required area, and a new main may be required. In addition, the tie-in point may be directly overhead or hundreds of feet away. The contractor may expect to be able to arrange a shutdown of the system and you expect them to wet-tap. The contractor may assume the requirement to meet local codes and your insurance underwriter expects coverage in excess of code, to meet its requirements.

This is an area where requiring code or insurance carrier compliance, within your specification, puts the burden on the contractor to investigate the issues; however, you must give them information regarding tie-in points, times, and the classification for the room.

Electrical

Electrical requirements for the facility should be determined to avoid the potential costly, and schedule impacting, need to get additional power delivered to your facility at the last minute. Existing power, voltage, and amps available should be determined in advance. This will help to delineate the scope of the cleanroom contractor.

If you are sure you require additional facility power, in advance of the cleanroom proposal submission, have the cleanroom contractor bring the required power to a single point of connection (this will require they include all load centers and step-down transformers). Your facility personnel can deliver power from the source to the single point of connection at the same cost as the contractor, and you will save their overhead and profit without compromising cleanroom performance responsibility. This is another area where the tool matrix is valuable, in determining power requirements for process equipment.

Controls

Controls are another area that can be significantly impacted by requirements, or more appropriately, by the lack there-of. Your process, regulatory agency, or customer may require data logging or other monitoring which should be understood and communicated up front. Your Facilities Department may require interface with their existing Facilities Management Program. You may wish to have energy saving setback, operating parameters, if the cleanroom space is not actively utilized during certain portions of the day, month, or year.

Controls are one of those items which you may not want to over-specify up front but will surely want to have detailed information on and review diligently when evaluating a proposal. A few words of caution:

- Use a control system which has modem and remote interface capabilities which can save time and money when attempting to troubleshoot operating issues.
- Stay away from proprietary systems which do not have components, or are not serviceable on the open market as they can be costly down the road.

Evaluating the Contractors

Before evaluating the proposals from your design/build contractors you must first evaluate the design/builders themselves. Ideally this should be done before asking the contractor to develop and present a proposal. Ask for information that will help you determine their abilities and resources, solicit financials or D&B reports, ask for a listing of ongoing and recently completed projects (then pick the projects which you would like to call for references). Ask the contractor to submit a set of design plans for a project similar in scope. Ask for resumes of the project team proposed, to interview them, how many projects they've worked on together, and to tour a project that they have completed.

Requesting Proposals

When requesting the proposal, ask for information which will help you compare the proposals for relative value and accuracy. At a minimum, you should be supplied with a proposed

- Project Schedule
- Floor Plan
- Reflected Ceiling Plan
- Equipment Plan
- Air Balance Schematic
- Details and catalog cuts of products and materials used in the basis of design
- Heat Load Calculations
- Power Requirements (rough order of magnitude)

These items should be readily available and part of an accurate estimating process as well as invaluable in understanding the similarities and differences from proposal to proposal. Don't utilize them to compromise the process: any information supplied by a design/build contractor should be utilized for evaluation of, and discussions with, that contractor only.

Evaluating the Proposals

Developing evaluation criteria, whether in a formal matrix form (with details and ranking) or informal comparison format, is essential to understanding the value versus price issue always inherent when you are not going through the traditional design/bid/build form of construction. You misuse and discredit the design/build process (and ultimately your own organization) if you take the cheapest guy and scope him to the best proposal. You can be sure the best value is in between. Throw out non-responsive firms who have not submitted the information you requested in the RFP document. Compare the remaining proposals utilizing critical information.

Do not select a contractor at this point: short-list 2 or 3 and interview them. The interview order should not be random; it should be based on the

criteria you set to help determine which firm best suits your needs. Most importantly, interview: what you will learn about these organizations during the interview process is most valuable.

Remember not to punish a contractor for thinking outside the box: if they develop a concept you don't like but which shows thought and ingenuity, don't throw them out: allow them to re-propose or amend their proposal after the interview.

Some of the items you should look for in the proposal evaluation and subsequently discuss in the interview are as follows:

Price Breakdown

Most important to evaluating the proposals: don't accept one lump sum price. Ask for a price breakdown, per trade, allowing you to evaluate where there are differences in proposals. This is not to beat people down against their competition, but to concentrate on comparison of proposals in areas of significant difference.

Architectural Evaluation

Architecturally your evaluation should consider the ceiling grid specified, filter type and efficiency (% filter coverage), walls system substrates, doors (number and type), windows, entrance and egress scheme and facility integration. This is why your RFP asked for the Floor and Ceiling Plans and catalog cuts.

Mechanical Evaluation

The mechanical portion requires critical evaluation as discussed previously. The heat load calculations and air balance schematic will help to evaluate cfm (in turn-air change rates), tons of cooling, make-up air, exhaust parameters, and what energy efficiency has been designed within the system, as well as redundancy. These issues affect operating costs and the ability of the room to function at times when equipment is down for service or repair.

If your cleanroom is required to operate every working shift to meet production goals, what

happens if a piece of equipment is down for repair for 2 days: what is the plan to continue to operate under reduced capacity? There would be none, if you have not designed in redundancy.

During the interview process, a significant portion of time should be spent on reviewing the heat load calculations and air balance schematics to understand fully how the values were determined. In addition, the catalog cuts submitted for HVAC equipment will help to understand the value and intricacies from proposal-to-proposal. Are the recirc air handlers manufactured specifically for cleanroom usage; are they double wall insulated: are there belts (which generate contamination) within the air streams. All of these items affect the hidden energy consumption and operating and maintenance costs that could take an inexpensive proposal and make it more costly over a short period.

During the evaluation process ask for energy calculations, if you require this information to accurately understand a proposal. Remember not to punish a contractor for thinking outside the box: if they develop a concept you don't like but which shows thought and ingenuity, don't throw them out: allow them to re-propose or amend their proposal after the interview.

Electrical Evaluation

Items which should be included in the electrical evaluation are the number of lights, the voltage, and whether they utilized energy efficient ballasts. Has the contractor included emergency lighting and exit signs? How many convenience outlets are incorporated in the design, and the overall facility power requirements including process, if within the scope?

Certification

Certification of the cleanroom should always be performed by an independent source with the criteria determined in the specification. The cost should be included in the contractor's estimate and the owner should reserve the right to

remove the cost from the scope and contract it directly, if they see fit. Remember that contractually the certifier is bound to the firm they are contracted with.

When the interview is done, ask a simple question. What will I have to do (as the owner) to operate this facility after your work is complete? This will help determine scope gaps and confirm an appreciation for the contractor's understanding of scope delineation.

Schedule

Schedule should be negotiated and included with any design/builders contract to protect both parties against unforeseen delays which impact the contractor's ability to control time related costs and the owner's ability to expect completion and avoid delays.

Conclusion

Reviewing the outline we have set forth, the process for reaching an accurate design/build contractor selection should include setting a basic criteria, communicating the required proposal deliverables, preparing an evaluation matrix, interviewing the short-listed candidates, understanding the value inherent in the conceptual design, and choosing the most technically-sound respondent.

To be clear, this is a process to deliver alternate paths to a predetermined point. The proposals should be evaluated on their own merits (price vs. value) and a selection should be made based on that process. Cheapest isn't always less expensive, and the lowest price isn't always the best value.