Part I

Roles and Responsibilities

1

Piping

This chapter will define the terms used for the lead in charge of the piping effort. It addresses how people are selected for that position, defines the duties of that position, and defines the duties of the four piping subgroups.

Piping engineering lead (PEL) as a title, a function, and a position has a very narrow, industry-specific application. This position is not widely known outside the process plant engineering and construction field. The position of orchestra conductor also has a narrow, industry-specific application, but it is one that has wide public recognition. The title *welder* is not so industry specific and is also commonly known to the general public. The same can be said about *bookkeeper, accountant, cook, or lawyer.* You can find each of these names, titles, or professions in any dictionary. Each is also commonly known to the general public. The position *piping engineering lead* is not commonly known to the general public.

Over the years, people have asked me about my job. What is my title, and what are my job duties? I would then need to explain what it meant and what I do. If I were a plumber, I would not need to explain what I do for a living. So, how do we define this position?

The piping engineering lead is the person who is placed in charge of all piping-related activities on a major process plant project. A PEL is a technical expert/resource supervisor/production manager. He or she is responsible for the overall plant and equipment arrangement; for the technical definition of all the process system piping on the project; and for the supervision of a large group of people. The PEL is responsible for the deliverables from their effort and for the quality of that effort. The PEL

also manages the budget and schedules aspects of the assigned segment of the project.

The actual PEL responsibilities vary depending upon the engineering company, the client, the type of project, the project execution philosophy, and the construction philosophy. Some companies (U.S. or worldwide) have the piping function integrated with another engineering group or function. Some companies structure piping in some other fashion. The specific structure is not as important as the overall function.

To fulfill all the aspects of this functional definition, and depending on the company, the PEL may be involved in some or all of the following activities:

- Participate as a part of the proposal team in pre-bid meetings with the client for proposal development
- Define the physical scope of the piping effort for the project (see chapter 10)
- Define the piping execution method and the required piping deliverables (see chapter 10)
- Prepare a labor hour estimate for the piping effort (see chapter 11)
- Prepare a material cost estimate for all piping items (see chapter 11)
- Prepare a detailed piping discipline work execution schedule that is coordinated and compatible with the other engineering disciplines (see chapter 12)
- Plan all aspects of piping activities (see chapter 13)
- Organize electronic or hard-copy data files or data needs (see chapter 13)
- Oversee proper resource (people) requisitioning and utilization (see chapter 14)
- Recognize and report all scope changes or trends that may cause a cost impact to the project (see chapter 15)
- Be aware of labor budget expenditure, production, and productivity (see chapter 16)
- Prepare prompt and accurate status reports (see chapter 16)
- Manage project completion and closeout (see chapter 17)

If you are already knowledgeable about the engineering and construction business, this list of activities will speak volumes. If you are new to the business, it may tend to scare or confuse you. Rest assured that is not the purpose. The purpose is to provide a guide for the person who is new to supervision, the person who is just getting started as a lead. It is also intended to help the person who is already a supervisor and wants to

improve. The goal is to show who we are and what we do as piping engineering leads.

How does one become a PEL? People come to this position by a number of paths. A PEL may be a graduate engineer with a BSME (or other degree) who has been in the piping material engineering group or the pipe stress engineering group. The PEL may be a transfer from another discipline, such as a mechanical equipment engineer. In today's world, however, these would still be considered rare cases. Most PELs will be from the plant layout and piping design arena. They usually are the ones who have been in the business much longer than anyone who reports to them or much longer than any of their counterparts in the other disciplines. Most of these PELs are there because of the vast experience and the "gray hair" technical knowledge they possess. That depth of experience and the knowledge they bring to the project are invaluable.

Many of the PELs that I have been privileged to work with or have met through contacts over the years seem to have gotten their start the same way. They took drafting in high school or a vocational technical school, or they worked in a central drafting department in their first job. The ones that showed an affinity for piping stuck with it and grew. They moved up the ladder, becoming more and more knowledgeable as piping designers. If they were lucky, they worked for a company that developed and conducted piping-specific technical training classes. Some were fortunate to live in an area where a number of local companies would join together and sponsor programs like the Engineers Club in the Philadelphia, Pennsylvania. Over the years, they worked on bigger and more complex projects. As they moved up the ladder, getting on-the-job training and experience, they became better piping designers. Some of these individuals also gained or showed leadership traits.

For most people in the PEL position, the bottom line, education wise, was that tried and true: OJT. On-the-job training (OJT) was the only way to learn. Some PELs may have had the benefit of some type of supplemental college-level classes. Some may possibly have attained a degree in some related field. Many, however, will have only a high school education with some college or junior college-level courses in subjects that relate to the piping field. The lack of a higher level education in the piping-specific engineering and design field was not by choice. The fact is that until recently (see chapter 18) there has not been a formal program in academia to addresses this specific field. This lack of a formal education, however, has not been a significant issue.

Although the skills that a PEL must have in order to succeed are many, the traits the PEL should have are few and simple. Every PEL will have a different background of life experience, project type experience, and personal habits. Two PELs who may work together for years for the same employer will not be, or think, alike. However, the basic traits that identify them as the person in charge are the same. I refer to these traits as technical (T), administrative (A), and leadership (L). These three major traits create a triangle with one other trait, personality (P), in the center. Each PEL can be looked at and evaluated on the basis of this (T-A-L-P) triangle.

A manager who is thinking of promoting someone to the position of PEL would do well to consider the T-A-L-P traits of the individual first. The manager should ask these questions: Is this person being promoted solely because they have been here for a long time, and they are now at the top of their scale? Are they being promoted because of their technical skills? Does this person know about and accept the administrative aspects of the job? What type of leader might this person be? Does this person have the personality to be a good representative for the company? Will they be compatible with other discipline leads, project managers, and clients? The responsible manager knows that people should not be promoted for the wrong reasons.

Any individual who is currently at the top of the technical ladder and thus on the threshold of becoming a PEL should think about how they fit the T-A-L-P triangle. A person who is impatient or impetuous and is driven to become a PEL just for ego should also think about the T-A-L-P triangle. What is T-A-L-P?

The *T* stands for "technical." No two PELs will have the same knowledge base, and there is no single definition of exactly what the PEL needs to know from a technical standpoint. The best way to state this is that the PEL should know as much as possible. The PEL should have in-depth knowledge of what it takes to execute the piping portion of a project. The PEL needs to spend time in the plant layout and piping design group. The biggest share of the piping work effort and budget is concentrated in the design group. It would be good for the person to spend time in each of the piping subgroups. Another way to gain the required knowledge is to attend company training programs and seminars focused on these areas. Active day-to-day contact during the normal execution of a project is also a key element to the learning process. A person who is interested in moving up in this profession must have their eyes and ears open, show interest, and be inquisitive about the right things. There are ways to broaden one's

technical knowledge base outside of the company. You can go back to school and take courses like basic process chemistry, metallurgy, welding, or others that relate to the field. Another good way is to seek short-term job assignments that are industry related. These jobs may include work in a pipe fab shop, as an operator in an operating plant, or in field construction.

The *A* stands for "administrative." If you do not like paperwork, you will have a rough time in any leadership role. Becoming a PEL is no different. There is a lot of paperwork in the engineering and construction business. There are scopes to write and estimates to prepare. There are schedules to develop, personnel appraisals to prepare, and timesheets to approve. There are reports to read and write and budgets to monitor. The list goes on and on. The administrative duties and the paperwork can become tiresome and can appear to be overwhelming. Paperwork must not be overlooked or left undone. The PEL candidate must understand that the curse of paperwork comes with the position. The key is to learn what is required, get organized, learn quick and simple ways to do it, and then do it. Do not allow yourself to fall behind.

The *L* stands for "leadership." The ability to be a leader is not something you can completely learn in school. Some schools and consultants claim they can make you a leader. All of us have known people who have attended these classes and still are not leaders. The person must be endowed with some of the basics of leadership in order to succeed. The schools and consultants can and will teach what to do and how to do it. They cannot teach feelings. A leader must have feelings. A leader does not get behind people and push them to accomplish a goal of which they are not in sympathy. The leader will make sure that the goal is worthy, logical, and attainable. The leader will be in front, providing an atmosphere that makes people want to reach the goal. A leader will know what to do and when to do it. A leader will know whom to ask and what to ask. A leader will be thinking 2 to 3 months ahead of anyone else. Another aspect of leadership is the ability to organize the job—having the right tools, having the right answers, and having a place for everything and everything in its place. This can help to develop the leadership persona.

These three traits—technical, administrative, and leadership—form the three sides of the triangle. In the middle of this triangle is the fourth trait, the most important one of all. The *P* stands for "personality." It will not matter how much you know about the technical issues. It will not matter how good you are at paperwork, bookkeeping, and timesheet approval. It will not matter how clever you are at giving orders. If your personality is not suited for the job, then you will have a very hard time being a piping

engineering lead. I do not mean that a person cannot have a bad day occasionally. Everyone has had the occasional flub or uncontrolled outburst that could have or should have been handled in a more diplomatic manner. I have had my share, and I have regretted them all. However, the person who is always angry, consistently aggressive, or overly abusive is not a good candidate for the position of lead.

There is another sort of person who does not make a good lead. This is the person who got promoted by accident. They did not ask for the job and are not inclined to be a leader. There is a famous management book titled *The Peter Principle.* In this book, the author describes what happens to a person who gets promoted to a position that is beyond their capabilities. Prior to promotion, these people usually are doing a very good job. They are also very happy in that job. After the promotion, they struggle to do the new job. They are just not able to do the new job the way it should be done. The individual did not want the job, knew they could not do the job, and were not happy. The promotion turned out to be wrong all the way around. It is not good for the company, not good for the other workers, and not good for the individual.

When people fail after being placed in the wrong job, the cause is usually lack of knowledge. You cannot prevent an uneducated person from making mistakes. We are not talking about uneducated people here. We are talking about very intelligent, very smart people. Any individual who is contemplating a position as a leader should seek whatever information might be appropriate to help them decide. This goes for the PEL position in their current company or the one at the company across town that had the tempting ad in last weekend's newspaper.

What does being a PEL mean? The aspiring PEL might say: "I know piping; I know my job." "I have been doing this for 20 years." "We pipers do the piping plan drawings, piping section drawings, and sometimes piping isometric drawings." "Sometimes there are specifications and standards, but those are done by the engineers." Here, we have one of the main points of this book: Piping is NOT just piping plan drawings, piping section drawings, and (maybe) isometrics. Remember that first familiar circle of light mentioned in the preface of this book. Plans, sections, and isometrics are the items in that first circle of light for someone who came from the design side of piping. A materials of construction engineer who is assigned to the PEL position will be most familiar with piping material specifications. I have also met ex-construction field piping engineers who have moved back into the office and become PELs. These people were more familiar with the endgame part of piping. Each of these individuals

brings value to the position of PEL. Each, however, needs to have the lights turned on in as many of the other (unfamiliar) areas as possible. They and the people they work with, above, or below need to know the full scope of the piping discipline.

What is meant by the phrase "full scope piping engineering"? The process piping systems on a project really do have a cradle-to-grave (full scope) span of requirements that needs to be handled by someone. What is required to take a new pipeline from the process engineer first marks on the piping and instrument diagram (P&ID) to pre-start-up? For each piece of piping material required to make the finished plant work, there are steps that must be accomplished by someone. Some will say that is not done at their company: They might say they leave that up to the contractor. That may be true. I am not trying to define who should or should not be a part of the overall process. I am trying to help people recognize the all-encompassing aspect of the overall process itself. A part of that recognition of the (action) elements in the overall process will be the realization that someone makes the process happen.

Let's look at this cradle-to-grave concept. For this exercise, let's assume that process engineering has a change order to add a new exchanger (10-E-152) on the P&ID. A number of lines are required, including a new line from a vessel (10-V-101) to the exchanger. The line will be a large diameter (14 inch) high-pressure line operating at 650° Fahrenheit and will include a control valve with full block valves and a bypass, plus the normal vent and drain valves. The line has a temperature element (TE) and a pressure indicator (PI). The large block valves are long delivery items that become the critical path. The project is full engineering, procurement, and construction management (E, P, CM). (See appendix B for the detail listing of action.)

This line does not get added just because someone draws an isometric. Someone must prepare the design criteria. Someone must prepare the specifications and standards if the current project specifications are not adequate. Who were those mysterious engineers who prepared the specifications and standards on past jobs? Who were the people who did the material take off (MTO) and prepared the request for quote (RFQ) packages? We know they existed because we know the work got done. Let's assume that they really did exist as a part of the piping department, but their relationship to the designers was not as clear as it could have been. Being a PEL means that it is clear to you, and you see the full picture. You know what your resources are; you are able to manage your resources. You understand the responsibilities, and you accept accountability for all the pip-

ing on the assigned project. At most companies, piping is considered a total responsibility discipline. You as the PEL and the people you work with need to recognize it as such.

Who do you work for? In this book, we will not discuss the pros or cons of being employed by a small company versus a large company. The size of the company is not important to the execution of the project or the actual PEL position. However, I do feel it is important that each individual understand whom they work for and what is a proper order of personal priority.

First, you work for yourself. The "you" is really you, your spouse, and your family. Each of us needs to understand that we should take care of ourselves and our families first. If we do not, then we will not be able to do a good and proper job for someone else. Second, your profession (at least at this time) is piping. You have an obligation to your profession. If you compromise your ethics or your technical integrity, then you hurt yourself and your profession. Doing a good job, a quality job, is what marks you as an expert in your profession. It is what allows you to be chosen for the next prime assignment or be promoted to the next higher classification. It marks you as someone who is wanted when people put together the next project team. Third, you are employed in the piping department of company X. While you are employed at X, it is the best and most important company in the world. You may not really like this company. You may not plan on staying there the rest of your life. That is okay, but while you are there, you owe the company your complete loyalty. Finally, you are currently assigned to a project for a client. This client deserves the best you have to give.

The biggest problem for most people is the apparent conflict of interest between the functional department with a department manager and a project with the project manager and the client. This is called *dual accountability.* What does dual accountability mean? It is very important to know and understand to whom and for what you are accountable. Accountability is another way of saying, "Who do I report to and why?" As previously stated, you are employed in the piping department of company X, and you are assigned to a client project. This means that there is a dual accountability. Is this a case of "whatever the client wants, the client gets"? No! Remember, clients come and go. Is this a case of "whatever the project manager wants, the project manager gets"? No! Projects and project managers also come and go. You are still employed by company X in the piping department. You are still a piper. Dual accountability means that you "render unto Caesar that which is Caesar's." Issues that relate to the project scope, project budget, project schedule, or project deliverables are items for which you are accountable to the project manager. What is done

and when it is done have a project focus. Issues such as staff utilization, piping code compliance, and product quality are items where your accountability is to the company/department manager. How things are done and who does them have a functional department focus. You are accountable to yourself for honesty and professional ethics.

Am I accountable to the client for anything? Yes! You are accountable to the client, but indirectly. You will have satisfied client accountability when you meet your obligation to the project manager. Being accountable means that you are held explainable for something (responsibilities) to the people you report to. The subject of reporting will be covered in more detail in chapter 16. Accountability has two sides. This is what we call middle management. The piping lead, as with the other leads, is in the middle. A middle management leader is accountable to those he or she reports to. They are also accountable for those who report to them.

The piping engineering group is traditionally the largest group on a task force project. Each of the piping subgroups specializes in a different piping engineering or design-related function. Henry Ford introduced and perfected the production line concept in the automobile industry. This method required people trained in different tasks to perform those tasks in the proper sequence. This concept allowed businesses to produce more for less. The heavy engineering-related business we are talking about here also uses a production line concept. We require people trained in different functions to perform all of the project tasks in the proper sequence. Some functions are a part of the traditional piping department and report to the PEL. Others are people outside the piping discipline or department (for example, structural engineers) and will be discussed in chapter 2.

Who reports to the PEL? In most companies, there are four major functions or subgroups that perform the traditional piping activities that will occur on a project. I want to remind everyone that this is a generic version: Your company may call them by some other name.

The functions or activities that report to the PEL are as follows:

- Piping materials engineering—Piping and piping-related materials of construction definition
- Piping design—Plant layout, piping layout development, and piping design documentation
- Piping material control—Material take-off, bills of materials, piping material RFQ, and purchase order generation
- Pipe stress engineering—Pipe stress analysis and specialty pipe support design

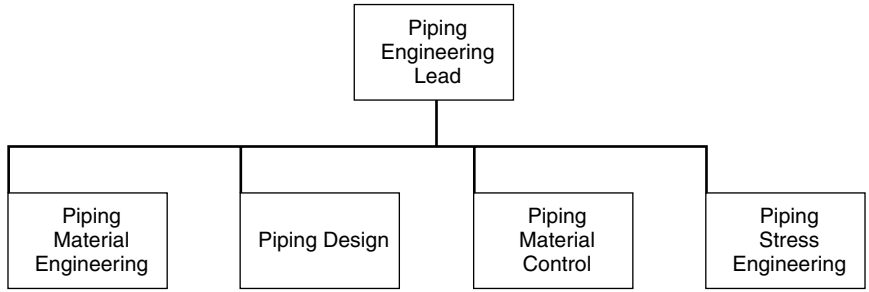

Figure 1-1

The piping materials engineer (PME) or the person who performs the tasks of the PME should report to the PEL. The PME may be the first member assigned to the PEL's team. This assignment may have occured during the proposal phase when there was a need to evaluate technical requirements for the bid. The PME is responsible for developing the master specifications covering materials of construction for all of the piping systems. Piping-related materials of construction definition would be included, also. Specifications for piping materials of construction include pipe, valves, fittings, flanges, bolts/nuts, gaskets, branch conventions, fabrication criteria (PWHT), and installation criteria (seal welding). Specifications for piping-related materials of construction include insulation, paint, and other special coatings. Using the data provided by the client and process engineers, the PME develops detailed specifications for the piping material. The specifications address each commodity with pressure-temperature ranges as allowed by the code.

The early definition of the required materials and the development of the project-specific piping material line class specification is a high priority for the piping team. With most projects, 75 to 80 percent of the piping material line classes will be easy to determine from the general scope data. Utility services such as steam, condensate, natural gas, fuel oil, domestic water, plant air, instrument air, cooling water, nitrogen, and others will be easy to identify and will normally use materials that are not long delivery. Process streams that include high temperature and/or high pressure could require systems with exotic materials that have restricted sources and long deliveries. Front-end coordination with process is an essential aspect of material procurement success. The material selection diagram (MSD) effort is required to properly define the types of material required on the project. If this important step is ignored or is performed too late, the project will suffer, and added cost may be imposed to recover.

In some companies, the PME may also be responsible for the proper selection of the line class for each line on the piping and instrument diagrams (P&ID). As a part of this line class specification exercise, the PME may also develop an initial listing of all lines. This document may be known by many names. It may be called a line list, line index, line designation table, or some other name. The choice of the name is not as important as the document itself.

Another important duty of the PME is the identification of and proper specifications for specialty items. It is not always prudent to write absolutely every piece of piping material into the piping material line class specifications. There are those odd items needing special handling by the PME. They may be items such as injection quills, pig launchers and retrievers, swivel joints, or loading arms. These are no doubt referred to by different names in different companies; however, they will simply be called specialty items in this book. The PME will need to work with the process engineer on the job to define the purposes, design, and operating conditions and then work with piping design and one or more vendors to satisfy the requirements.

The list of piping deliverables the typical PME will produce may include the following:

- Piping material line class specifications
- Piping material purchase specifications or technical notes
- Insulation specifications
- Pipe painting specifications
- Piping line list
- Specialty (SP) item specifications
- SP item list

The piping design group (PDG) reports to the PEL. The PDG is normally the largest single group on a process plant task force. The lead piping design supervisor (or squad boss) will normally be assigned to oversee the designers who will perform the detailed design stage of the project. The lead design supervisor should be available for the job kickoff meeting and should be deeply involved with the project from the beginning. The person who is assigned as the lead design supervisor is in a position similar to the vice president of the United States. That position is just one step away from the top spot.

This group is typically responsible for the overall plant layout. There may be some types of plants where another engineering entity may take the lead for the plant layout. Readers will need to recognize this and make

the required transition in their thought processes. Most major process plant projects in the refinery, petroleum, chemical, petrochemical, power, fiber, and many other businesses will have the fundamental plant layout and equipment layout done by the piping design group. The PDG will normally produce the project master plot plan drawing. The PDG will be responsible for the definitive equipment placement and layout. The equipment layout will be "fit for purpose" when considering the process requirements. The PDG will be responsible for all piping layout development and for working with other engineering groups to define physical plant needs and clearances.

The piping design group will route all piping. They will ensure proper support and flexibility of all lines. They will guarantee that all in-line instruments are properly accounted for and that all equipment and piping are in accordance with the project design criteria. They will consider criteria for operation, maintenance, safety, and constructability. One of the major milestone activities conducted on a project is that final confirmation that everything is done. There are various methods that may be employed by PDG to do this. The method I like is the piping design supervisor's P&ID isometric continuity, "yellow-off." With this method, the lead piping design supervisor yellows off every isometric against a set of up-to-date master P&IDs. After this activity has been completed, every pipeline and every piping-related item on every P&ID should be yellow. It is also not enough for that supervisor to simply yellow off the isometrics. When something is missing from the isometric or when something shown on a P&ID is not in the correct place (or orientation) on the isometric, then the supervisor needs to take action. I have spoken in terms of using piping isometrics for this activity. Piping isometrics are not the only documents that can be used for this. If the isometric is the primary piping design document to be released on a project for purchase, fabrication, and installation of process plant piping, then this is the document that should be used for the cross-check against the P&IDs.

The potential list of piping design documents is long. Not all jobs require all of the different document types. It is likely that some companies have never had a need to develop some of these documents. It is also possible that a document was, in fact, developed but was developed by some group other than PDG and, consequently, was known by another name.

The list of piping deliverables PDG will produce may include the following:

- Piping specifications (The term *specification* is used here and in other places in this book to define a document that will be a deliverable for use

by a vendor or a subcontractor. The information may also be formatted in a less formal manner and called *technical notes.*)
- Project plot plan (overall plant) and unit plot plan(s), also known as GAs
- Piping transposition (piping one line), also known as geographic schematic
- Piping standards and piping details
- Vessel orientation layouts and equipment layout studies
- Piping drawing indexes
- Piping plans and piping sections (elevations)
- Piping isometrics
- Heat tracing drawings
- Piping demolition drawings
- Piping tie-in drawings and tie-in list
- Demolition and removal drawings

Piping designers will also be required to go to the job site on any revamp project that includes piping. It is not advisable to gamble that the existing drawings might be current. The existing drawings must be checked against the actual physical plant, and the drawings must be corrected before any work can be started. Piping design on a major process plant project will also play a big role in the management of the computer-aided design (CAD) model. All disciplines must work together in one single CAD model just as they must in the real areas of the project. If one group does not participate in the CAD model, then the project might just as well not have the model at all. This is a case of everyone or no one, and coordination and communication are vital.

The piping materials controller also reports to the PEL. The piping material control (PMC) function is primarily accountable to the PEL for material requirements planning. Again, depending on the company, the PMC function may not exist or may functionally report to a different department. However, when required for the project, the PMC function is responsible for all piping material. This includes quantity take-off activities, production of bill of materials, piping material quantity summaries, piping material RFQs, piping order bid tabulation/summary, piping material purchase order generation, and required-at-site (RAS) date planning.

The list of piping deliverables the PMC will produce may include the following:

- Bill of material for each piping document
- Bill of material summaries

- Special take-off summaries (large diameter or long delivery valves)
- Piping material procurement request for quote (RFQ) draft
- Piping material procurement purchase order (PO) draft

The pipe stress engineer reports to the PEL. The pipe stress engineer (PSE) function is accountable to the PEL for all pipe stress analysis and specialty pipe support design. The PSE may produce specifications for any spring hanger supports, expansion joints, or piping stability strut devices. The PSE consults closely with the piping designers to review and approve selected pipe lines depending on the job type and project criteria.

The list of piping deliverables the PSE will produce may include the following:

- Spring hanger specifications
- Expansion joint specifications
- Piping sway strut specifications
- Formal stress calculations
- Deadweight, wind, and force and moment loading for pipe supports or equipment nozzles

At this point, one might ask, "If these four groups do all that, then what does the PEL do?" Good question. The PEL will be very busy. The PEL will traditionally be the first piper assigned to the project. He or she will be involved in the early planning phases of the job. The PEL will be responsible for drafting the piping scope of the work. The PEL will do all the initial estimates and schedules. There will be many, many meetings to attend, and there may be trips to the job site or client offices. The job execution will be completely thought out and planned. Later, as the job progresses, the PEL will review all work to ensure that it is in accordance with the plan. The PEL will also be responsible for making periodic reports. It is not unusual to have weekly and monthly reporting to both the project and the department manager.

No two companies will be organized in exactly the same way, function in the same manner, or use the same mode for project execution. Depending on the company, piping's project execution will typically fall into one of two traditional formats. These two formats are generally recognized as the functional department format and the project task force format. The size of the company does not have any bearing on the chosen mode for project execution. Most large engineering firms in the engineering, procurement, and construction (EPC) and engineering, procurement, and construction

management (EPCM) design-build business choose to execute projects in the project task force format. Small companies and a large company performing a very small project will use the functional department format. The functional department format has its good points and should be used by companies both small and large when it is appropriate. The project task force format also has benefits, the major ones being the gathering of all the people in one location for the duration of the project and the shortening of the lines of communications for everyone. The particular project execution format used by a company is not addressed in this book. Both have their merits and should not be judged as either positive or negative.

Because of long-standing industry tradition and the nature of the overall process plant design process, piping is a prime interface point for all other task force groups on the project. Piping is also a key factor in the proper and timely execution of many other task force work activities. The PEL needs to fully understand piping's role in the overall production line of the project. Piping is not now and never will be the only group involved. Piping is not the first group involved or the last group involved. Piping is surely not the most important group involved in the project. Piping is just one of the groups that make a project happen. In the next chapter, we will discuss the other engineering groups and their relationship to piping.