Control building design process

Blast and storm resistant façade (left); and prototypical gas processing control room and warehouse (right), in Texas, US *Source: PageSoutherlandPage*

Jeffrey S Willis, *a Senior Vice President and Director of Science & Technology for the Houston office of PageSoutherlandPage, reviews the key considerations to be made when designing control buildings on gas processing sites.*

The development of natural gas plays around the world requires economical control building solutions to meet the needs of operations personnel at midstream processing and fractionation facilities. In the US alone, drilling has increased dramatically, with the rotary rig count currently standing at just over 2,000 – up from only 488 in 1999. In fact, that figure has jumped more than 15% in the past year alone, and continued rapid growth is expected for the next 20 to 30 years.

Control building design requires the consideration of many factors not commonly encountered elsewhere in the built environment. It is imperative that design teams have a committed focus and full understanding of the highly complex requirements of such facilities, along with the local building codes and applicable national standards, in order to effectively locate, plan and design the building on time and within budget.

Five key considerations

This article looks at five key considerations when siting and planning control building facilities on midstream natural gas processing plants. The principles discussed are also applicable to control buildings and network operations centres for natural gas processing and petroleum refining sites.

Key consideration #1 – Site

A key factor in determining where to locate facilities on a processing site is the mitigation of risk to personnel and property loss. A formal risk analysis (scenario planning) that considers risks and seeks solutions to complex interactions is an important precursor to designing the facilities. This effort needs to be overplayed with site logistics and security considerations, including features such as man-traps (a security device that monitors and controls two interlocking doors to a small room that separates a non-secured area from a secured area; these interlocking doors allow only one door to be open at any time) and vehicle restraint systems.

Key consideration #2 – Environmental assessment

Understanding the environment where the project will be located is critical. Natural factors in the environment such as earthquake, tornado and flood threats are important to consider. Man-made factors like over-pressure (blast) zones should meet industry standard recommended practices like API RP 752 *Management of hazards associated with location of process plant permanent buildings*. Avoiding risks posed by vapour clouds while safely accessing the facility by on-foot personnel, company trucks and delivery vehicles needs to be carefully considered.

Risks to personnel responsible for operating process controls also need to be analysed. Providing facilities and systems to adequately respond to inadvertent releases requires specialised consideration of building pressurisation, with appropriate filtration for potentially contaminated ventilation air. Elevating facilities above floodplains is fundamental. Determining by how much is based on building code, insurance requirements or sustainability standards. Strengthening the building shell is an important consideration where facilities are located in windstorm areas.

Key consideration #3 – Facility scope

Corporate standards, indoor environmental conditions and the consolidation of like services in a single multi-purpose facility are key tools and components necessary to efficiently design a modern facility. Interviews with corporate planners, engineers and operations personnel yield valuable insight into the facility needs. Establishing the goals, determining the needs, collecting and analysing facts while uncovering and testing concepts, help to frame the issues and desired outcomes for the facility.

The human-machine interface of control buildings vary from a simple computer located on a desktop to that of a complex network operations centre featuring multiple video walls. Understanding the user's goals and needs is vital to creating the appropriate indoor environment. Temperature and humidity control for computer equipment, video consoles and personnel are typically straightforward. However, challenges for even the best engineers and architects include ergonomics; filtering of dust, pollen and specific air contaminants; maintaining a heated or cooled environment during a process upset event or providing acoustics so operators can communicate in a calm and normal tone of voice.

Control room design must take equipment failure and its online repair into account. Designing building systems to provide control room operational redundancy may be critical to the function of the facility. Redundant heating, ventilation and air conditioning equipment and its support systems should be evaluated. Policies stating how support equipment and systems are to be maintained need to be clearly understood. It may not be acceptable for operations or maintenance staff to disrupt or distract control operators in order to change filters or repair equipment bearings. If so, such systems will need to be located remotely from the control room area and will impact the overall construction budget.

Model building codes are important resources and tools in the design of facilities for both domestic and international locations. When like facilities are combined, there is typically a first cost saving. Seeking opportunities to combine like use and occupancy groups into a single facility is a valuable tool for controlling construction cost. There are at least 10 occupancy groups listed in the International Building Code (Chapter 3, Section 310). Some occupancy groups may be combined without significant impact, while others are more cost effective to locate remotely from one another.

Key consideration #4 – Future facility planning

Gas processing plants are dynamic environments. Frequently, the site is designed to allow for the installation of the gas processing trains. Consideration of future expansion opportunities for facilities should also be considered and, if deemed necessary, planned. It is unlikely that all elements of the control building will need to expand if, or when, the plant expands. The impact of those elements of the programme – control rooms, data halls or office environments – likely to expand should be evaluated, with the location and method of expansion planned at the initial planning stages.

Key consideration #5 – Budget

Project success is typically measured by how well the project aligns with the cost *pro forma*. Since facilities only account for a minute percentage of the overall project budget, little effort is customarily put into establishing detailed requirements during the early stages of the project.

One common mistake is starting design prior to developing the space list. Such an oversight most often results in redesign and unacceptable schedule deviations. Obviously, the facility must be fit for purpose, including the correct complement of workstations and amenities.

To be successful the project scope must be aligned with the available project budget to achieve the targets prior to starting the front-end engineering design (FEED) or space layouts.

The basis for a pre-FEED concept-level estimate is a detailed space programme and associated budgetary cost per square metre. A space programme begins with a comprehensive list of required and optional spaces. Once the pre-FEED concept-level estimate is established, the space programme can be reconciled and efficiently adjusted to align with the budgetary targets. Control buildings contain numerous opportunities for the development of prototypical space programmes and design solutions which can be customised to specific project locations. ●

** With more than 20 years' experience as a practicing licensed professional engineer, Jeffrey S Willis has recently worked with energy clients including ExxonMobil, Shell, ConocoPhillips, ONEOK Partners and Abu Dhabi National Oil Company. He currently serves as Vice Chair for the American Society of Mechanical Engineers ANSI B31.9 Building Services Piping Code Committee.*