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(713) 242-1190

On-line Flow Computers for Liquid Custody Transfer

Class 3140-1

Gail Powley, P.Eng
Vice President
Willowglen Systems Inc.
8522 Davies Road NW
Edmonton, Alberta, Canada

Introduction

Flow Computers for custody transfer are critical elements in running a pipeline – as each acts as either the Cash Register or the Toll Booth and therefore a financial focal point. Therefore it is key that Flow Computers be installed correctly for both technical and business purposes. New pipeline expansions have many elements, many players, and therefore many considerations to ensure that the Flow Computer portion of the overall project goes about smoothly. This paper will focus on effective practices of Flow Computer Project Management, based on over 30 years of experience on flow computer projects completed across North America, on oil liquids pipelines ranging from small to large. Paper elements also include: the role of the flow computer, considerations for manifold design, information management, and lessons learned.

Project Management Practices

Core to the successful implementation of any new system, is the use of strong project management principles, practices, and techniques. There is often the temptation to skip standard project management procedures, and jump straight to the technical solution – which always endangers the effectiveness of the implementation, and most certainly the time and effort that the project takes for completion.

Assembling and Managing the Project Team

Kick-off meetings held with all affected parties and needed team members should be done at the earliest opportunity – after the project manager has completed a high-level assessment of the project needs (scope) regarding resources (personnel, materials), facilities, schedule and availability. Building a RACI Matrix (Responsible, Accountable, Consulted, Informed) is an important technique to ensure that all project personnel are identified up-front, and for subsequent effective and time-efficient decision-making. By holding early 1-on-1 consultations with key stake-holders, the project manager can confirm the manner in which each team member needs and/or wants to be involved, which not only produces their buy-in (as they understand the role they have to play), but also allows them to understand their early opportunities for input – which avoids both future project delays and in general misunderstandings.

Project Planning: High Level Technical and Personnel Requirements Breakdown

In general, most flow computer projects can be broken down into 6 major technical elements, in addition to the standard project management stages. All elements are related, and as the majority of the time is spent at the design phase – a full upfront understanding of the specifications is critical to an accurate and effective design – and overall installation.

Six (6) Major Flow Computer Project Technical Elements:

- Specification
- Design
- Manufacturing/Configuration
- Testing
- Commissioning
- Full operation

An early review of these project elements is not only important for overall project execution planning, but in identifying all team members.

Flow Computer Stakeholders

In addition to any projects personnel, it is key to consider the needs of the end-users of the Flow Computer System. Therefore, by taking a 'start to end of life approach', not only are the installation teams considerations taken into account, but also considerations of the overall operations, maintenance, and data-use team members. The list of who interacts with the Flow Computer can be very extensive and includes the departments of/related to: Operations, SCADA, PLCs, Gaugers / Electricians, Measurement, Leak Detection, Production Accounting.

Flow Computer-Related Instrumentation

After a consideration of "who" interacts with the Flow Computer, the next element is to focus on "what" interacts with the Flow Computer. The flow computer requires the input and effective operation of many instruments – therefore, the proper selection, installation and calibration of this equipment is critical. Major elements of the instrumentation list include:

- Meters
- Pressure Transducers
- RTDs
- Densitometers
- Viscometers
- Valves (Hand/Motorized, Single/Variable)
- Limit alarms (high pressure, low flow)
- ESD alarms
- PLCs
- Sample solenoids
- Weigh scales
- Prover

As this list is quite extensive, it can be seen that full consideration of all elements are required for the proper design, installation, and execution stages of the project – for effective on-going flow computer use.

Flow Computer Design Considerations

As mentioned, the Flow Computer design stage is by far the most time intensive component of the Flow Computer Project. In addition to the core decision of Single or Dual Marshalling, important considerations include placement of instruments, choices of appropriate valving, and sampling methodology selection.

Single or Dual Marshalled: Single is typical for PLC cabinets as it is faster; however, dual marshalling allows for separation of signals (analog, digital; AC, DC), speeds up troubleshooting of cable faults, and increases ease of system design and layout, ease of construction, and ease of commissioning.

Placement of Instruments: Whether the Temperature / Pressure measurements are placed at the Header or at a Meter makes a difference, recognizing that there is Temperature gain past friction points, and pressure drop over a length of pipe.

Valving and Sampling Methodology: Type of valves used includes considerations for motorized valves, which have their own pros and cons. Sampling methodology can vary from company to company – and their interpretation and implantation of standard practices.

Information Management – External and Internal Teams and Documentation

As many parties (internal and third-party) are involved in pipeline installation and expansion projects, information management and the timely sharing of information at the design stages is an important consideration for effective flow computer project management. A sample of these stakeholders includes:

- Pipeline Company
- Engineering Consultants
- Flow Computer Manufacturer
- Sampling Building Manufacturer
- Commissioning Coordinator
- Site personnel

The information management is largely executed through electronic document management and the acceptance/sign-off by the appropriate parties. The many documents involved include:

- Process and Instrumentation Drawings (P&ID)
- Instrument and valve wiring drawings
- Sampling building drawings
- Construction drawings
- Calibration sheets
- Control narratives
- Shutdown key procedures

While these documents are required for design, even more documents are required through the project design and execution stages. As these documents are required for on-going operation and maintenance, care needs to be taken to ensure that they are not only easily referenceable and accessible, but kept up to date. It is critical that changes to any of these documents are sent to the relevant stakeholders as soon as possible to avoid future conflicts.

Often questions arise during the wiring or configuration of the Flow Computer. It is important to get accurate, definitive answers to these questions. An official form that clearly outlines the information request and requires signoff on behalf of the responding party helps to address this issue. It solves the problem of traceability that verbal confirmations create. It also often creates better, more complete, responses since the responder is signing off on the answer. This method can help to avoid surprises and delays towards the end of a project.

Flow Computer Project Implementation, Validation, and Execution

Diligence during the Flow Computer design phase will lead to a configured product that meets the requirements of all project stake-holders. However, validation of the Flow Computer once implementation is complete is just as important in ensuring that the product meets the needs of all project stake-holders.

Validation is done through two key-steps: factory acceptance testing (FAT) and site commissioning.

Factory acceptance testing is performed at the vendor facility using the Flow Computer and a set of tools to simulate real inputs and outputs. It is important that both members from the vendor and the end-user are involved in this process. During this stage, the end-user can make any concerns known to the vendor before the Flow Computer is sent to site. A formal checklist is essential and helps guide the validation process.

Site commissioning (also known as site acceptance testing) is performed at the site on the real system, usually during a shutdown. Again, it is important that both members from the vendor and the end-user are involved in this process. This stage is the last chance for problems to be found before the Flow Computer moves into production. Once again, a checklist should be used to ensure that all equipment is functioning as expected. It is also critical that all as-built documentation, calibration certificates, and equipment specifications are available at the site as this stage. Missing information can lead to delays, mistakes, and other issues.

Conclusion

Flow Computer projects and effective installation are more complex than many organizations realize, therefore having good practices in place in both project and technical management levels is important – to not only keep the installation project on schedule, scope, and budget, but in providing accurate measurement and ease-of-maintenance and use over the long-term.

Understanding and awareness of all technical elements is key, and is an area where experience becomes invaluable.

Many companies are faced with the added complexity of outsourcing project components to third parties, therefore, the need for effective planning and information management is stronger than ever before – and has gone from a 'nice to have' to an essential in ensuring that the overall project goes about smoothly.

As always, the critical element of a successful project is good teamwork, as no matter how well a project is planned – factors such as weather, health and availability of team members, and more are beyond complete control. Therefore, there will always be a need for individuals to pull together to deliver exceptional performance. Building a united team mentality, from initial buy-in at the project kick-off stage through to final project execution is the surest way to ensure project success.

References

Project Management Institute Global Standard, "A Guide to the Project Management Body of Knowledge (PMBOK)", Fourth Edition, An American National Standard ANSI/PMI 99-001-2008, ISBN:978-1-933890-51-7