

DESIGNING ACCURATE METERING STATIONS: FROM CAD TO COMMISSIONING

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The Role of Design

Every company and industry needs to balance getting work done and planning to get work done. For industries like gas transmission and distribution, the designer is the bridge between planning and doing. A designer properly vetting the design and installation process can ensure the success of the metering application (Dickenson, 2019).

In other process piping applications, metering may impact production capacity but overall impact can be hidden due to inefficiencies in other equipment. However, in a metering station, the cost to quality measurement directly figures in the thousands of dollars (Edgar B. Bowles, 2002).

Because of these factors, the outcome from a solid design process should result in a $\pm 0.5\%$ bias and reduced operational headaches (Edgar B. Bowles, 2002).

To make the complexity of gathering requirements for a project, companies typically standardize on the following process, which is broad enough to cover more than metering design.

1. Project Scoping – Capture site data, flow requirements, design constraints, design basis memorandum
2. Front-End Engineering Design (FEED) – preliminary P&IDs, layouts, equipment lists and cost estimates.
3. Detailed Engineering – detailed 3D modeling, finalized P&IDs, equipment specifications, instrumentation plans.
4. Issued for Bid/Construction (IFB/IFC) – drawing package released for procurement and field execution.

One key step the most consistent and successful design teams use is to maintain a project requirements checklist. The goal of such a checklist is capturing decisions and boundaries that shape the project. Throughout each phase of the project, the checklist may be populated with new information or changes to previous decisions. At the end of the project, the design team often merges key items back into a template so that critical items are carried project to project.

The category represents the purpose or owner of the item, priority is captured using High (H), Medium (M), and Low (L). The risk for each of these must be assessed by the involved parties.

Category	Requirement	Priority (H/M/L)	Primary Impact Area	Risk if Not Addressed (for H items)
Process & Flow Data	Minimum, normal, and maximum flow rates (actual & standard)		Accuracy, Capacity	
	Future load growth (+20–50% margin recommended)		Capacity, Future-proofing	
	Bi-directional flow requirements		Operations	
	Design pressure (MAOP), operating range, test pressures		Safety	
	Gas composition / quality data (SG, H ₂ S/CO ₂ , contaminants)		Accuracy	
Site & Location Data	Exact site coordinates, plot plan, footprint constraints		Layout, Cost	

Category	Requirement	Priority (H/M/L)	Primary Impact Area	Risk if Not Addressed (for H items)
Metering & Measurement	Environmental conditions & restrictions (flood, seismic, etc.)		Safety, Compliance	
	Preferred meter type & number of runs		Accuracy	
	Overall uncertainty target (e.g., <0.5% bias)		Revenue, Disputes	
Operations & Maintenance	Flow conditioning & verification meter provisions		Accuracy	
	Maintenance access (platforms, clearance for calibration)		Ops Efficiency, Safety	
	Bypass requirements		Reliability	
IT/OT & Instrumentation	Filter/separator or drainage needs		Reliability, Maintenance	
	RTU/flow computer & SCADA/comms requirements		Operations, Data	
	Power source & backup		Reliability	
Safety & Regulation	Overpressure protection philosophy		Safety	
	ESD and relief/vent requirements		Safety	

The example above provides a framework for capturing and resolving design decisions. Each company tends to decide their own structure, but be careful not to overload teams with a heavy list of information to put in from the start. Keeping it simple up front helps align the team to the value as they work through the new process.

To avoid over-detailing the list, keep in mind that the main purpose is to track items that require coordination between multiple groups or impacts multiple groups. The check list is not the place to store information a designer or engineer can be expected to understand as part of their role.

The Design Process

While the designer must coordinate and implement the requirements and feedback from many groups, their core proficiency should be in validating placement, routing, orientation for cost, construction speed, and maintainability.

Design Foundations

Good metering station design starts well before the first line is drawn. The standards that govern how a station must be built — AGA, API, and others — define specific physical requirements that shape every design decision. A designer who doesn't know these standards well will produce drawings that look complete but fail in the field.

The table below lists the primary references a designer should have at hand. These aren't background reading — they're working documents that set the tolerances, straight-run lengths, and installation requirements your design has to meet.

Before getting into the tools, a few principles are worth stating plainly because they show up in every standard on that list:

The standards are minimums, not targets. AGA 3 sets the floor for orifice meter design — plate tolerances, tube diameters, upstream lengths. Designing to the edge of those allowances is a choice with consequences. Conservative designs perform better over time and audit better when a billing dispute comes up.

Upstream piping is the most common source of measurement error. Every standard says some version of this. Elbows, tees, valves, and reducers upstream of the meter disturb the flow profile. Each standard specifies the distance required to recover that profile, and it's longer than most people expect, especially in tight footprints. If you can't provide the required straight run, you need a flow conditioner, and that choice has to be made in the design, not in the field.

Meter selection has to match the actual operating range. Minimum, normal, and maximum flow all matter — and so does the 20–50% growth margin that most operators eventually wish they'd included. Gas quality matters too. Specific gravity, moisture, H₂S, and contaminants all affect meter performance and have to be accounted for in the design basis before a meter type is selected.

Instrumentation is a design input, not a late addition. The flow computer, RTU, and SCADA architecture affect measurement uncertainty. The configuration of the flow computer has to match the calculation standard named in the custody transfer contract. Mismatches between those two things are a documented source of billing disputes — and they're entirely preventable if the IT/OT scope is defined early.

Uncertainty has to be calculated, not assumed. A design that can't demonstrate it meets the $\pm 0.5\%$ bias target isn't ready for issue. The uncertainty calculation traces from the primary element through the transmitters to the flow computer. If any link in that chain is underspecified, the target is at risk.

The table below identifies currently available classes and documentation that directly support metering station design work, with a description of each resource and its type of learning content.

Resources – Metering Station Design

Source Name	Description	Type of Learning Content
AGA Gas Measurement Manual, Part 9 – Design of Meter and Regulator Stations	Provides guidelines for the design of meter and regulatory stations, including station specifications, regulators and control valves, piping configuration, meter types, automation, and preparation of natural gas for market. A foundational reference for any station designer.	<i>Industry Technical Manual / Reference Document</i>
AGA Report No. 3 / API MPMS Chapter 14.3 – Orifice Metering of Natural Gas (Parts 1–4)	Four-part standard covering general equations and uncertainty guidelines, specification and installation requirements, natural gas applications, and background implementation procedures. Specifies meter tube dimensions, orifice plate tolerances, flow conditioner requirements, and upstream straight-pipe lengths critical to accurate station design.	<i>Industry Standard / Technical Report</i>
AGA Report No. 9 – Measurement of Gas by Multipath Ultrasonic Meters	Covers meter performance requirements, design features, testing procedures, and installation criteria for multipath ultrasonic meters used in fiscal (custody transfer) applications. Provides guidance on upstream	<i>Industry Technical Report / Standard</i>

	piping configuration and installation effects relevant to station layout.	
AGA Report No. 7 – Measurement of Natural Gas by Turbine Meter	Details the theory of operation, performance characteristics, installation, and maintenance of turbine meters. Describes flow computation techniques, density and rangeability considerations, and calibration/testing procedures for turbine-meter-based station design.	<i>Industry Technical Report / Standard</i>
AGA Report No. 11 / API MPMS Chapter 14.9 – Measurement of Natural Gas by Coriolis Meter	Offers general criteria for custody-transfer measurement of natural gas using Coriolis meters. Includes meter requirements, quality assurance, installation effect guidance, and encourages designers to consult manufacturer test data for upstream piping configuration impacts.	<i>Industry Technical Report / Standard</i>
API Manual of Petroleum Measurement Standards (MPMS), Chapter 5 – Metering	Provides general considerations for the selection, design, and application of flow measurement equipment in petroleum and gas systems. Covers meter station layout, installation, and operational considerations applicable across both liquid and gas metering disciplines.	<i>Industry Standard / Reference Document</i>
GTI Energy – Measurement and Regulator Station Design (Distribution & Transmission)	A 4.5–5 day instructor-led course (available in-person and virtually) covering pressure regulation, overpressure protection, pressure control facility design, system metering for optimal accuracy and ease of maintenance, retrofitting and replacement considerations, and safety compliance. Offered through GTI Energy's Registered Gas Distribution Professional (RGDP) certificate program.	<i>Professional Training Course (Instructor-Led / Virtual)</i>
GTI Energy – Introduction to Gas Measurement and Pressure Regulation (Measurement and Regulation Fundamentals)	A 3-part virtual instructor-led series introducing the fundamentals of measurement and regulation facility design. Targets personnel who design or influence measurement and regulation facilities in transmission and distribution systems, as well as OEM representatives.	<i>Professional Training Course (Virtual Instructor-Led Series)</i>
ASGMT – American School of Gas Measurement Technology (Annual School)	The largest gas measurement school in the United States, founded in 1966. Offers over 120 lecture classes and 54 hands-on product training sessions annually. Curriculum spans fundamental measurement, gas sampling and chromatography, gas regulation and control, measurement audit, and metering station design topics. Provides CEUs through Texas A&M Kingsville.	<i>Annual Industry Training School / Conference</i>
ASGMT – Gas Measurement Fundamentals (GMF) and Liquid	Dedicated 3-day courses (in-person and virtual) with 11 lecture classes (GMF) and 13 lecture classes (LMF). Instructors have been heavily involved in developing and maintaining AGA/API measurement	<i>Professional Training Course (Specialized Short Course)</i>

Measurement Fundamentals (LMF) Courses	standards. Students receive a comprehensive guide and proficiency testing with a certificate of competence upon passing.	
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TABLE 1. Metering Station Design

Implementing Design

The tools available to a designer vary widely. This section gives an overview of the design landscape rather than a deep dive on any specific tool. From the advent of drawing boards to generative design, the purpose has always been the same, to serve the construction and operations process. One practical note: designers rely heavily on vendor information to define specific design requirements. When that information is accurate and arrives early, the design reflects it. When it's late or incomplete, the design does too.

Companies delivering design packages generally focus on 1-2 main platforms. While some companies are large enough to support multiple platforms, companies generally select what they can support based on the clients and projects they are trying to win.

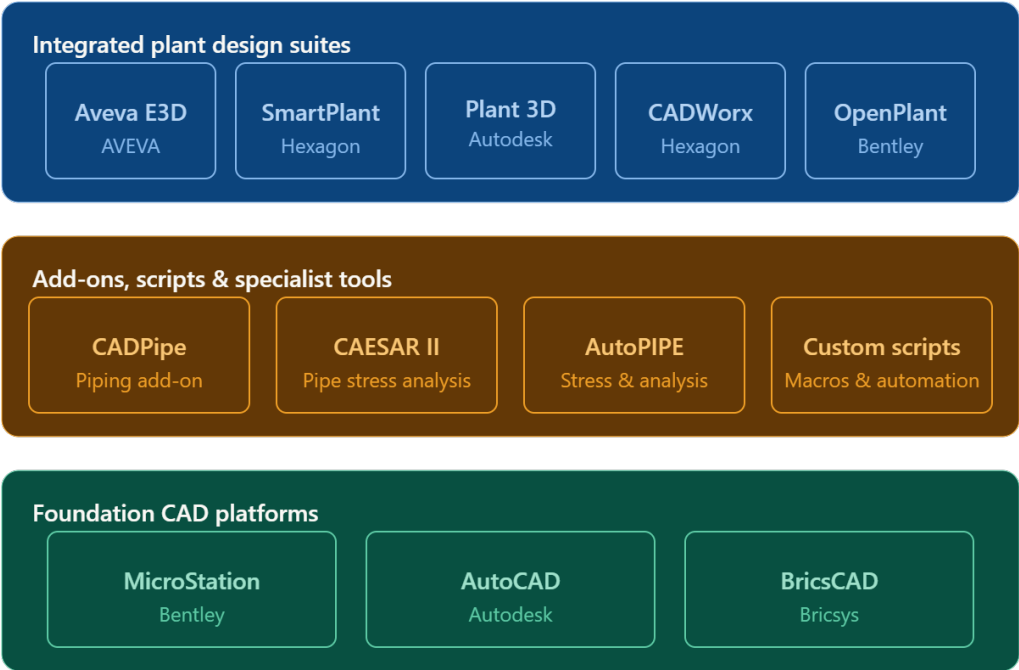


FIGURE 1. High level technology stack for design

The range of tools also moves from generalist tools like Microstation, AutoCAD, and BricsCAD to plant design focused suites like SmartPlant, Plant 3D, or the others. In conjunction with design tools, companies also need to pick a stress analysis tool that has some workflow capabilities with their design tool.

Whichever tool is chosen the main functions are thus:

1. Improve the creation and editing of design.
2. Provide improved visual understanding of the design.
3. Create materials lists for purchasing
4. Enhance communication about the footprint, position, and relationships in the design.

By delivering on these 4 key areas, design teams can provide clarity well in advance of the construction process.

Design Content

Design content is any text, object, or style that is used to communicate to the broader team. Content generally has these characteristics:

- 3D or 2D re-usable objects (3d gate valve, gate valve symbol on a P&ID)
- Property information (size, spec, pressure class, operator type)
- Standardized visual characteristics (color, linewidth, line type)

An effective design team will invest in a content library that is shared among the team. A high-quality content library increases communication because the broader team does not have to try to interpret 5 versions of the same object.

Design content is one of the key ways vertical design applications like CADWorx or AutoCAD Plant 3D set themselves apart from the basic tools.

When a company organizes design content, they must factor in how often it will be re-used and the level of detail. While modern device can make processing power feel infinite, highly detailed models can bring any software product to a grinding halt.

Understanding the source of content and who manages it helps validate where to spend time when we are establishing design content standards.

Geometry & symbols

Content type	Purpose	Why it matters	Source (author)	Who manages updates
Structural shapes & sections	Standard steel sections (W-beams, channels, angles) used for skid frames, platforms, and pipe supports	Ensures designs reference real, purchasable material sizes consistent with structural standards	Standards body	Application vendor
Piping components & fittings	3D and 2D representations of elbows, tees, reducers, flanges, valves, and other catalog items	Drives accurate material take-off and ensures components placed in the model match what gets ordered	Application vendor	Vendor + company
Equipment models	3D representations of vessels, meters, flow computers, filters, and other major equipment items	Allows layout and clash checking before construction; re-used vendor models save significant setup time across projects	Vendor + company	Company
Pipe supports	Standard support configurations (U-bolts, clamps, guides, anchors) placed in the model at design stage	Generic shapes are provided by the application but company standards define which configurations are approved for use	Vendor + company	Company
P&ID symbols	Standard instrument, valve, and equipment symbols used on piping and instrumentation diagrams	Industry standards like PIP provide a baseline but companies decide how closely to follow them — inconsistency between firms creates review friction	Standards body + company	Company

FIGURE 2. High-Level Content Design Organization

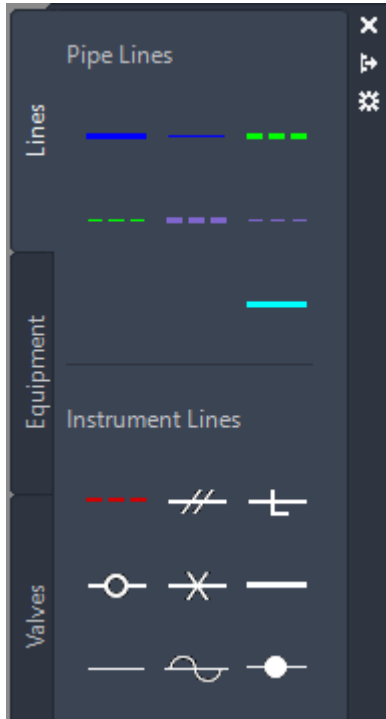


FIGURE 3. Example PIP Line types for P&IDs

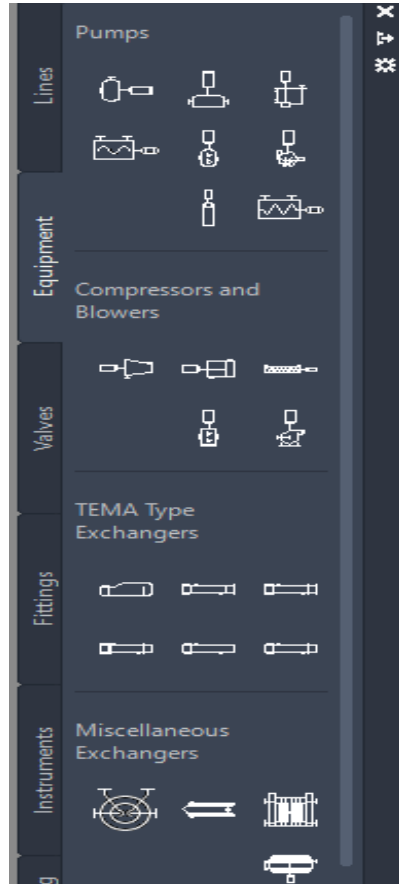


FIGURE 4. Example PIP Equipment for P&IDs

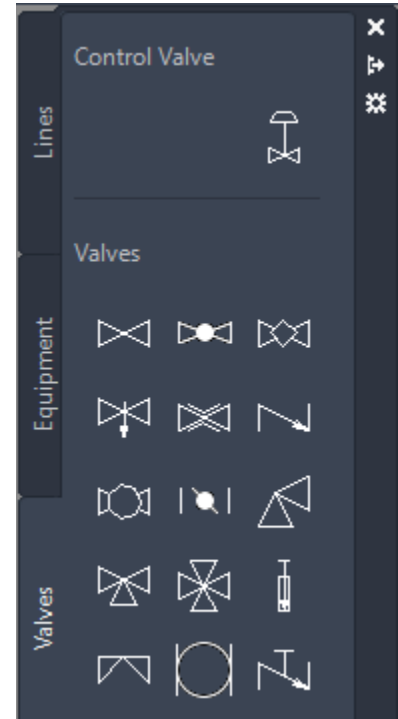


FIGURE 5. Example PIP Valves for P&IDs

Autodesk Spec Editor for AutoCAD Plant 3D 2026

File Edit Specs Catalogs Tools Help

Spec Branch Table Catalog

PRESSURE RELIEF VALVE, SPRING LOADED, T, RF, API 526

Part Family Properties

Long Description (Family)	PRESSURE RELIEF VALVE, SPRING LOADED, T, RF, API 526
Compatible Standard	API 526
Manufacturer	
Material	
Material Code	
Short Description	Pressure Relief Valve, Spring Loaded
Design Std	T
Design Pressure Factor	
Weight Unit	LB
Connection Port Count	2
Component Designation	
Is Symbol Type	INSTRUMENT-ANGLE
Is Symbol KEY	RAFL
Valve Alignment	Angle
Valve Detail	PressureRelief
Valve Body Type	Relief
Flow Dependent	☒
Offset	☐
Control Valve	☐

Part Family Connection Port Properties

1 2 All Ports

Delete Component Create Component

Part Size Properties

Sizes 8"x10" 8"x10"

Part Size Connection Port Properties

1 2 All Ports

Port Name All Ports

Nominal Diameter *Varies *

Matching Pipe OD *Varies *

Well Thickness

Engagement Length

Flange Thickness *Varies *

Size Parameters

D1	8.625
D2	10.75
L1	10.875
L2	11
X1	2.5591
X2	-2
H1	13.5
H2	16
W1	0
W2	0
A	90
OF	-1
B1	1.12
B2	1.16
DA	24.3065
HA	48.613
SPilot	0

Catalog Browser

ASME Valves Catalog

Family Size

Search

Size Range	Long Description (Family)	Short Description	Material	Material Code	Design Standard	Design Pressure Factor	Manufacturer	Port Name[1]	Nominal Unit[1]	End Type[1]	Flange Standard[1]	Gasket Standard[1]	Facing[1]	Pressure Class[1]	Schedule[1]	Port Name[2]	Nominal Unit[2]
2" - 3"	PRESSURE RELIEF VALVE, SP	Pressure Relief Valve			J			S1	in	FL			RF	1500		S2	in
3/4" - 3/4"	PRESSURE RELIEF VALVE, SP	Pressure Relief Valve			0.126 Sq. in.			S1	in	SW			RTI	2500		S2	in
1 1/2" - 2"	PRESSURE RELIEF VALVE, PI	Pressure Relief Valve			H			S1	in	FL			RTI	150		S2	in
1" - 1 1/2"	PRESSURE RELIEF VALVE, SP	Pressure Relief Valve			D			S1	in	FL			RTI	150		S2	in
1/2" - 1"	PRESSURE RELIEF VALVE, SP	Pressure Relief Valve			0.11 Sq. in.			S1	in	SW			RTI	150		S2	in
4" - 4"	PRESSURE RELIEF VALVE, SP	Pressure Relief Valve			P			S1	in	FL			RF	150		S2	in
1 1/2" - 2"	PRESSURE RELIEF VALVE, SP	Pressure Relief Valve			H			S1	in	FL			RTI	150		S2	in
1" - 1 1/2"	PRESSURE RELIEF VALVE, PI	Pressure Relief Valve			F			S1	in	FL			RF	2500		S2	in
1" - 1 1/2"	PRESSURE RELIEF VALVE, SP	Pressure Relief Valve			E			S1	in	FL			RTI	150		S2	in
3" - 3"	PRESSURE RELIEF VALVE, SP	Pressure Relief Valve			K			S1	in	FL			RTI	600		S2	in
1 1/2" - 2"	PRESSURE RELIEF VALVE, SP	Pressure Relief Valve			G			S1	in	FL			RF	2500		S2	in

FIGURE 6. Example Plant 3D catalog with geometry definitions and properties

Separate but related to industry-based content, each company manages its own drawing and project standards. By aligning these stylistic choices, they ensure continuity for their customers, construction teams, and internal reviews.

Drawing & project standards

Content type	Purpose	Why it matters	Source (author)	Who manages updates
Layer standards	Named layer or level structure that organizes geometry by discipline, system, or drawing type	Consistent layer naming is what makes external references and model coordination work cleanly; without it, visibility control breaks down during review	Company	Company
Text styles	Defined font, size, and weight combinations applied consistently across all drawing output	Prevents individual designers from making ad-hoc choices that break drawing consistency across a package	Company	Company
Dimension standards	Rules for how dimensions are displayed — units, precision, arrow style, text placement	A dimension that can be read two ways is a field change order waiting to happen; consistent standards eliminate ambiguity before construction	Company	Company
Table styles	Formatted templates for schedules, equipment lists, line lists, and other tabular deliverables	Structured tables feed downstream processes — material take-off, procurement, commissioning packages — reducing manual reformatting between handoffs	Company	Company
Title blocks	The bordered template on each drawing sheet carrying project name, revision history, approval signatures, and client branding	The title block is the legal identity of a drawing — it establishes who produced it, when, and at what revision; companies typically maintain a master and swap in the client logo per project	Client + company	Company

FIGURE 7. High Level Company standards categories

Model Organization

Each design tool also has a way to organize models together. Whether external references in AutoCAD, Zones or sites, or filters, design teams need to be able to isolate discipline work. Consistent organization for facilities, disciplines, and design teams streamlines communication.

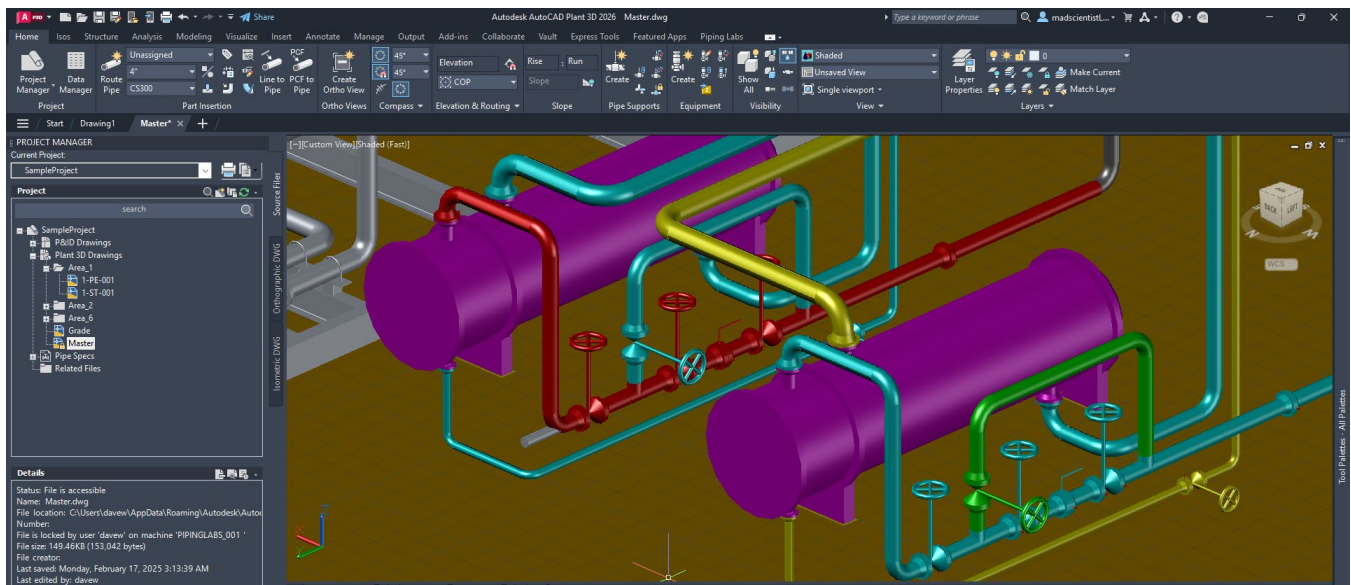


FIGURE 8. Example project structure with areas and disciplines

Output

The design process is also responsible for generating the deliverables by which the construction and fabrication processes will take place. While relationships between clients and design teams vary, commonly the design team issues a package with the following contents.

Discipline	Deliverables
Process & Instrumentation	Process flow diagram PFD — high-level overview P&ID Core document; all disciplines derive from this
	Instrument index Master list of tagged instruments Control valve datasheets Sizing, Cv, body material, trim Safety valve datasheets Sizing calcs per API 520/521
Piping & Mechanical	Plot plan Site layout & access routes GA drawings Plan, elevation & section views Meter tube drawings Straight run requirements per AGA/API
	Piping isometrics Per spool; fabrication & stress review Line list Design conditions & test pressure
	Pipe spec Materials & ratings by service Equipment list Tagged equipment & design parameters
	Valve schedule Type, size, rating & actuation
Controls & Instrumentation	Instrument datasheets Flow computers, transmitters, analyzers Loop diagrams Wiring & signal path per loop
	Termination diagrams Panel & JB terminal assignments Control system architecture RTU / SCADA / flow computer comms

FIGURE 9. Deliverable by Discipline Swim Lanes

Discipline	Deliverables
Electrical	Area classification drawing Hazardous zones per API 500 / NFPA 70 Single line diagram Power distribution source to loads Electrical load list Connected & demand loads Cable schedule Tag, type, routing, from/to
Civil & Structural	Foundation drawings Anchor bolts & concrete design Structural steel drawings Skid framing or building structure Grounding layout Ground grid, bonding & resistance
Supporting	Basis of design Standards, conditions & assumptions Hydraulic calculations Pressure drop, flow & meter sizing Material take-off Quantified list for procurement Vendor document list Tracks required supplier submittals As-built drawings Issued post-construction

FIGURE 10. Deliverable by Discipline Swim Lanes (continued)

Over the years, many design firms have elected not to include the design source files as part of a project deliverable. However, owner-operators should include the source files as part of their contract negotiation. By standardizing on a design platform for receiving source files, owners can save tens of thousands of dollars when they need to make changes to a site.

The most successful companies include the following criteria when receiving files from their design team.

1. Legal language defining acceptable formats for source files.
2. Required data formats for integration systems.
3. Design package requirements (specific naming, required drawing types, standards, title blocks).
4. Tools to validate a package (the design team can check for compliance on their own)

To support output requirements, the owner may provide templates that an engineering firm can use as a starting point. For example, providing project templates, drawing templates, report templates, or pipe support details saves the design team from having to create those from scratch.

By establishing what a good output looks like for key requirements, the owner ensures that when they receive a package for a metering station, their teams will be able to identify items that are out of compliance and focus on the hard work of integrating it.

Design Validation and Review

The common thread through the design process that requires continuous feedback and management is the design validation and review process. Internally to the design firm, checks and conversations are happening within the team daily. As new information is received or defined, the designer is responsible to incorporate the change into the model, P&IDs, and other deliverables. Coordinating and managing the complexity of the validation and review process can make or break the design of the meter station.

The scale of metering stations typically does not require stage gates like other large capital projects do, but often the process still follows standard milestone releases at 30%, 60% and 90% complete.

At these milestones, the proper quality control process will bring the broader team together to review the design. The earlier in the design stage changes are brought in, the cheaper the overall process.

The design detail level naturally matures, but at each stage make sure to provide feedback on the biggest risk items. To help for the turnover process, start detailing system boundaries as early in the review process as possible.

	30% — Strategic direction	60% — Detail correctness	90% — Ready for construction
Ops	◦ Metering & control philosophy ◦ Isolation & blowdown strategy ◦ SCADA / flow computer fit ◦ Meter run count vs. throughput	◦ P&ID line-by-line review ◦ Fail positions & ESD logic ◦ Sampling & prover locations ◦ HMI layout & alarm philosophy	◦ P&ID vs. model reconciled ◦ Startup sequence & PSSR scope ◦ Custody transfer docs confirmed ◦ Operability walkdown complete
Maint.	◦ Equipment access & pull space ◦ Drain / vent philosophy ◦ Spare parts & fleet standardization	◦ 3D model maintainability walk ◦ Instrument make/model standards ◦ JB & conduit routing ◦ Local indicators at grade	◦ Maintenance procedures drafted ◦ Spares ordered; O&M manuals received ◦ Loop check sheets ready ◦ Equipment tags reconciled
Const.	◦ Site access & laydown areas ◦ Construction sequencing ◦ Long-lead procurement flags ◦ Modular vs. stick-built confirmed	◦ Isometric constructability review ◦ Hydrostatic test packages ◦ NDE & weld requirements ◦ Cable routing & area class	◦ IFC drawings complete & consistent ◦ ITP & weld map finalized ◦ Tie-in plan & hot work permitted ◦ Spool pre-fab inspected

FIGURE 11. Mapping Review items to Milestones by Role Swimlane

The review process also commonly has its own set of tools to manage and interact with. These tools work to capture comments, track redlines, and organize feedback so design teams can act on it.

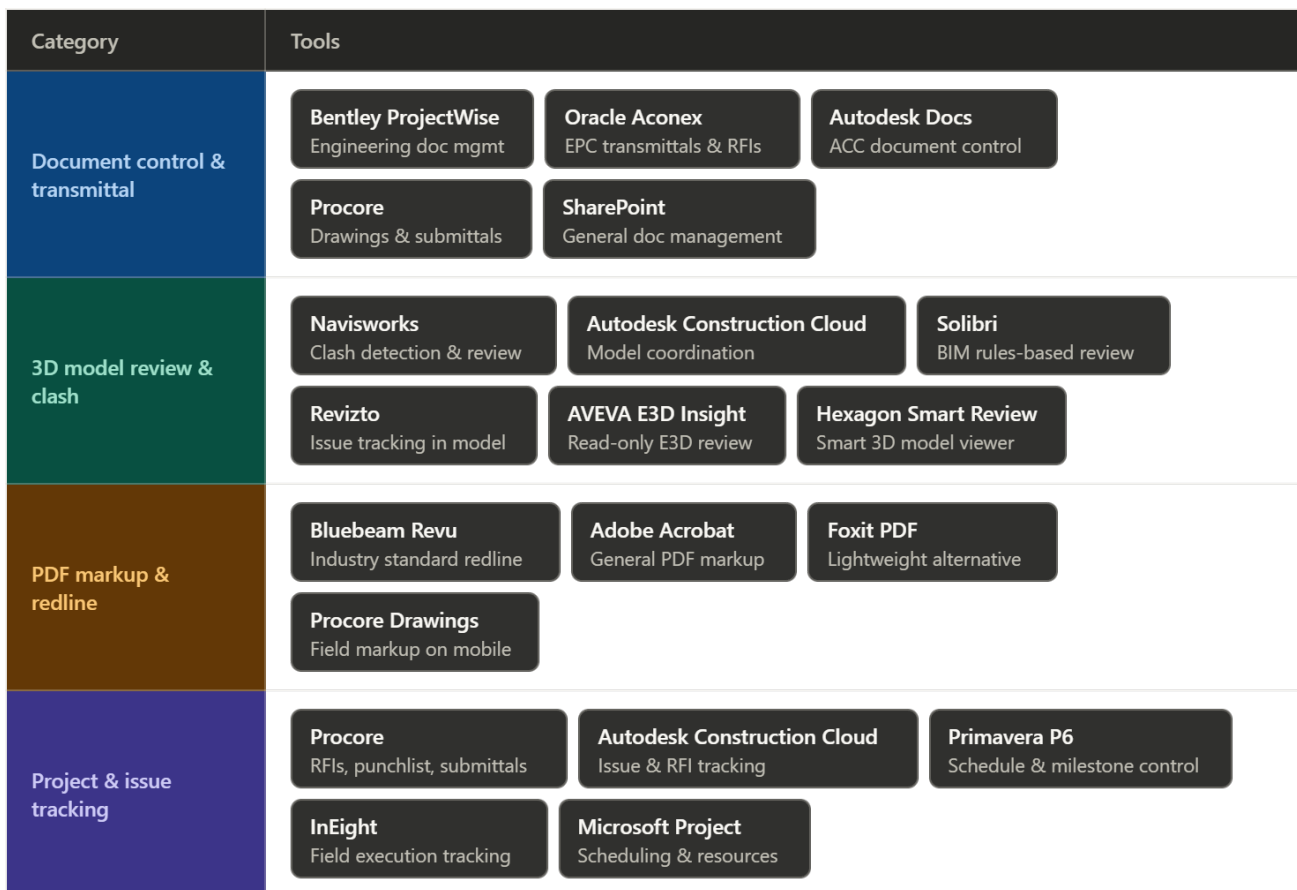


FIGURE 12. Review Technology Stack by Role Swimlane

During the design validation process there are a few key threads to manage across all teams.

1. Reviews – what products are used, how is access controlled, what window for feedback is allowed. Agreeing to and successfully managing the review window will ensure the design team can make changes as rapidly as possible.
2. Operational data points – narrowly focus on testing and validating data points feeding the operations team at every stage. These sets of data points should be automated to the degree that final handover is a simple pass/fail.
3. Design Practice - Design practice feedback items are the details that surface through the expertise of the teams involved. These items are least likely to be automated, but shared through team mentoring and interaction.
4. Clash Detection and Automation – Almost every software package has methods for reviewing 3D clashes. These are spots where structural steel or piping may be attempting to occupy the same 3D space. Clash reports should be run weekly, and every review session should capture the number of open clashes. These indicate clear and extreme construction risks.
5. Construction access and maintenance – one of the hardest aspects to plan is staging and sequencing construction. Some tools provide automation, but thinking through and planning the logistics of large equipment arriving on-site and getting erected should always be a key element of reviews.

The commissioning process can vary based on project size and scope. By maintaining a well-planned review process, the design phase of the project can transition to commissioning and handover with a high confidence level in the product being provided to operations.

The Hand Over

Rather than a single point in time, the handover is a phase during which the control of design and completed construction is passed to the owner. Additionally, the site isn't turned over as a complete unit, rather systems are released as they are verified and vetted.

Beyond providing requirements early in the design process here are some key ways to organize handover:

1. Define system boundaries early in the detail design process. By releasing in packages, each group can prioritize work in a way that streamlines handover.
2. Commissioning engineers engagement – have critical insight happen early in the review process helps improve the 60% and 90% quality.
3. Preservation and tagging – managing damaged or deteriorated equipment streamlines resolving disputes.
4. Documentation – operations having authority to reject handover, saves them headache trying to re-construct what was designed during critical moments
5. Handover coordinator – a single point of contact to own the process (not the results) will help keep punch lists, documentation and systems on track.

Handover Early, Often

As more of the design packages improve the types and quality of output (like digital twins), operations teams must allow time and schedule to validate those outputs. Rather than having a mountain of work after the physical handover is done, adopting a posture of testing handover packages early in the design process can save hundreds of thousands of dollars, and thousands of man-hours.

The goal of maturing handover processes is to front-load the integration and operational communications to a point where communication is most impactful.

In *From Data Sludge to Liquid Gold* (Jones, 2025) the author provides an example where shifting the attention to the digital requirements from the commissioning process to the design process saved 3,300 hours in asset data management. The motivation for shifting to a new integration process is for these types of results:

- 12 months ahead of schedule
- \$370k NZD savings over manual data entry
- 3300 hours labor hours (23,000 data points at 8 minutes per point)
- ~0 data processing data backlog

The Shifting Influence

Early investment, Maximum impact

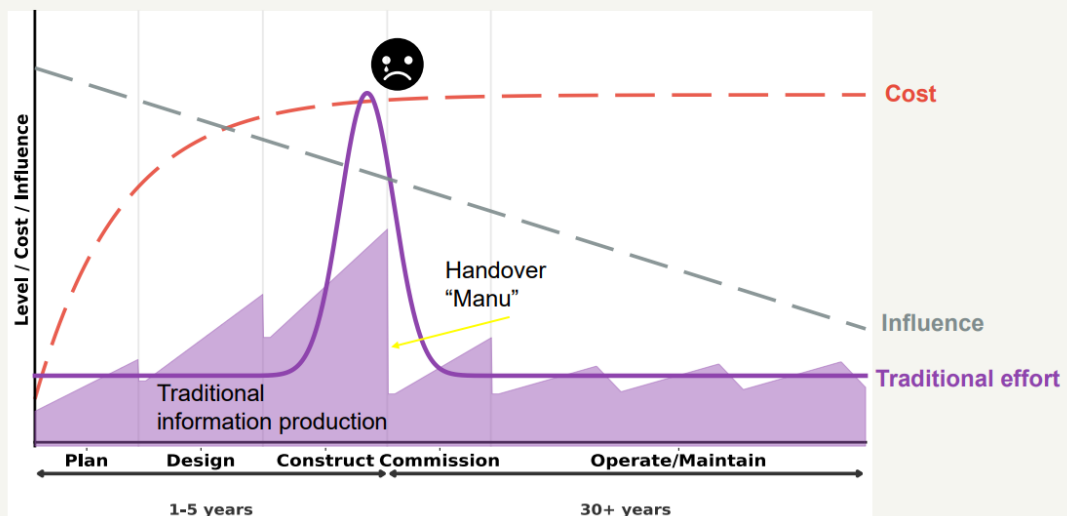


FIGURE 13. Traditional Handover process

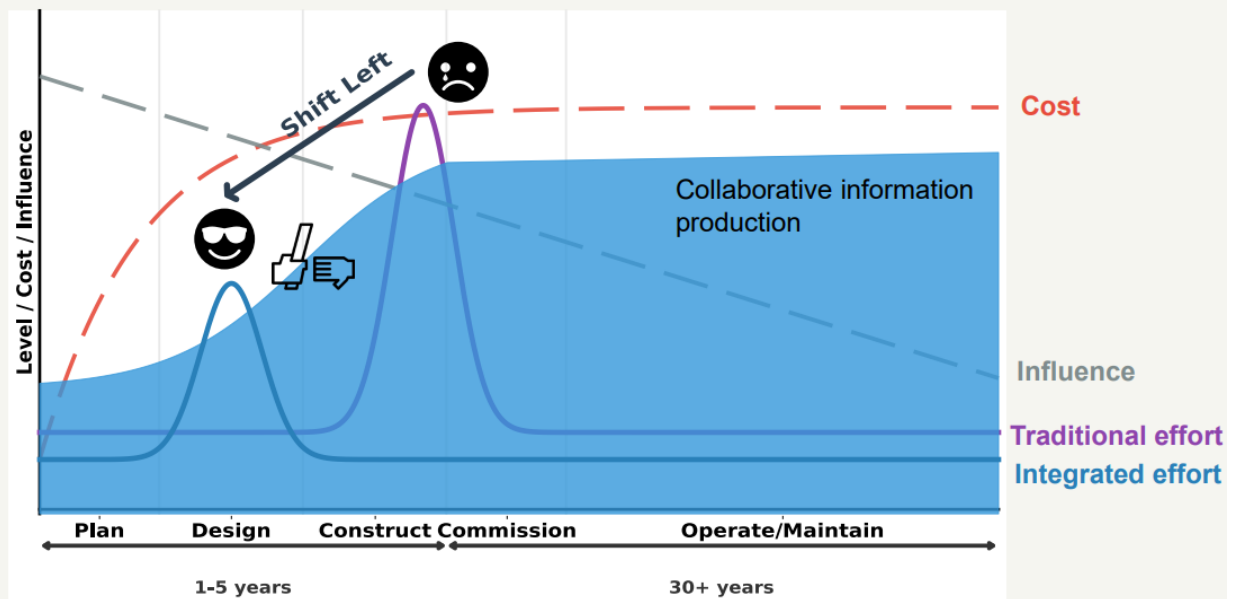


FIGURE 14. Integrated Handover Process

The key starting point is requirements capture. By reviewing previous commissioning efforts and identifying root causes for delays and costs overruns, operations should provide a prioritized list of requirements to the design and construction teams. By aligning on these and aligning on the highest priority requirement early in design, the entire team can build a micro-handover process that will be duplicated through the life of the project. In adopting digital initiatives, completing the entire workflow chain successfully is critical before trying to optimize any single portion of the workflow. This approach of focus on the highest operational value first and then walking it through each contributing team to success ensures that technology supports the team instead of steering the team (Gregolinska, Khanam, Lefort, & Parthasarathy, 2022).

Testing the Handover

By organizing our requirements and evaluating them against the phase of the project for when they can be addressed, all teams can align on how requirements get addressed.

Consider a familiar scenario: a new metering station is six weeks from startup. The flow computer has been commissioned, the meters are proving out, and operations is confident. Then corporate IT arrives for a routine network assessment. After scanning the OT subnet, they find several unexplained open ports: 8443, 5900, and 27017. The flow computer vendor's analytics package—the one sending performance data to the vendor's cloud dashboard—has been communicating externally through ports that were never reviewed, approved, or documented. The firewall rules reflected what the engineer assumed the system needed, but no one confirmed the actual port requirements with the vendor.

The station startup gets pushed three weeks while IT and the vendor go back and forth. The vendor's support team, based in a different time zone, takes four days to respond with a partial list. The owner's IT security policy requires a formal exception request for any non-standard outbound port. The exception request requires a business justification, a risk assessment, and sign-off from a manager who is currently on vacation. It is, as one operations manager once put it, a completely avoidable disaster.

To view an alternative, consider the outcome of providing input and review earlier in the process. As the review process gets standardized, automation can improve the checking process to prevent as much burden on the operations team. The key factor here is to first complete the manual workflow end-to-end before automating. Without the active participation of the team in the manual process, automation risks over-optimizing the wrong part of the work.

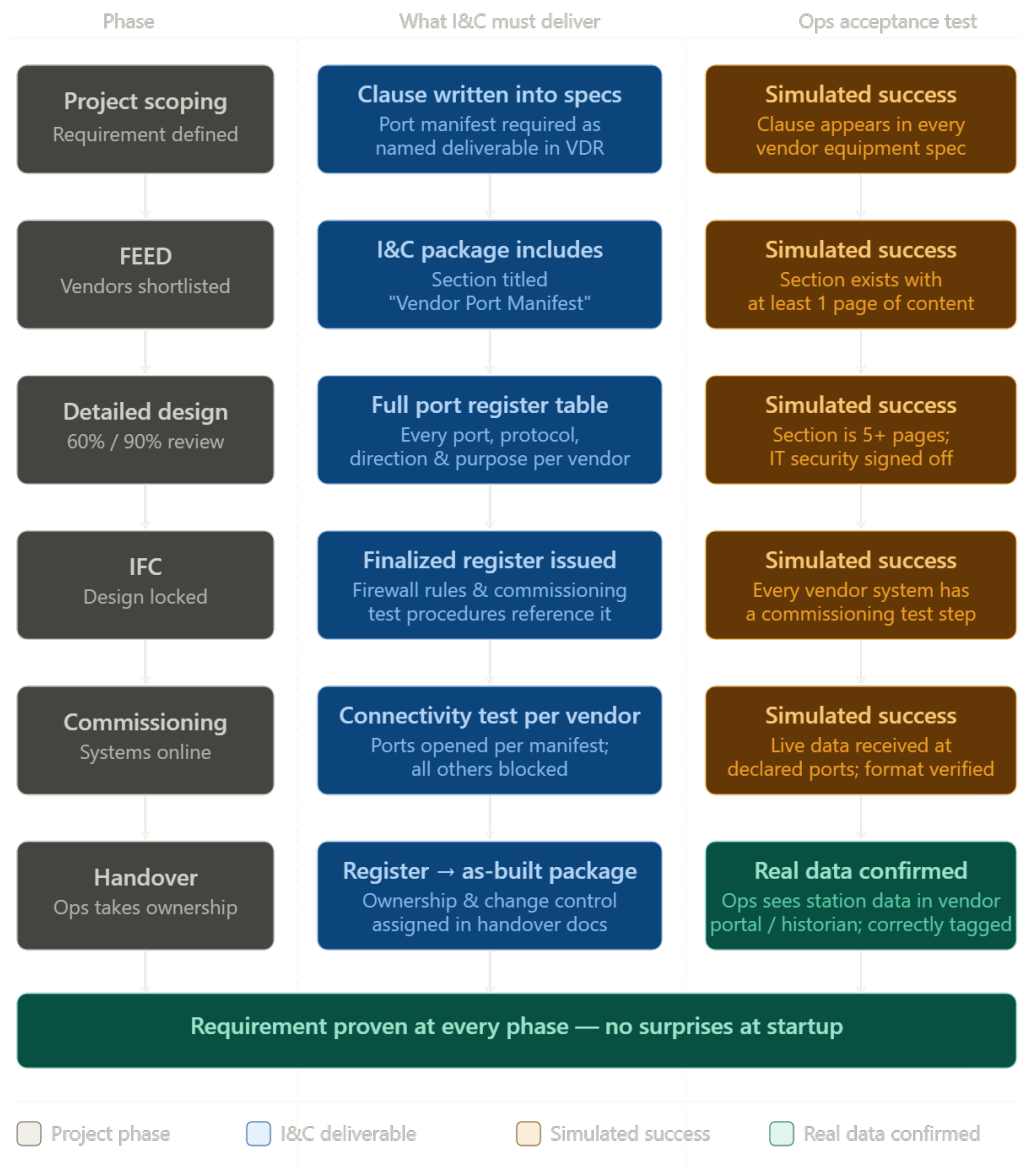


FIGURE 15. Integrated Handover process example

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