P&IDS, THE NEGLECTED BEST PRACTICE

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Introduction

The P&ID. The Process and Instrumentation Diagram. An essential element for the successful execution of any capital project and the go-to tool for trouble-shooting and optimizing mill processes. All engineering and operations personnel understand the value of P&IDs, so it is a certainty that the P&IDs for every Pulp and Paper Mill are up-to-date and accurately represent the current processes, right?

Well, not quite. But why not? Is it really all that important? Is it REALLY worth the effort to update and maintain the P&IDs on a continual basis?

In a word, yes. The benefits to future capital projects and every day mill operations mean a better bottom line. Let's examine.

The Life of a P&ID

Ideally

- Starts as a New Process and develops as the process develops over the design phase of the Project
- "Issued for Construction" when the design is complete
- "As-Built" when the installation and startup are complete
- "Rev. 1, 2, 3, etc." as the system is modified over time

Reality

- Starts as a New Process and develops as the process develops over the design phase of the Project
- "Issued for Construction" when the design is complete
- "May or May Not Be As-Built" when the installation and startup are complete. The time, money, and patience are going or gone and now it is time to make paper!
- "Rev. Never" as the system is modified (Who has the time?!) and only updated if required for a new capital project

The Status of YOUR P&IDs

- Be Honest!

Why is this the case? Because, like everything, it requires time and money to keep drawings up to date. Also, it is not always easy to quantify the costs of not keeping them up-to-date.

What Do Out-of-Date P&IDs Cost You?

Being hard to quantify does not mean that it cannot be quantified. The costs are either hidden in executing a capital project or unknown until a crisis emerges. Even then, the costs are not generally associated with out-of-date P&IDs.

Capital Costs

Every capital project should begin with collecting the relevant P&IDs for the mill and verifying their accuracy. If you are going to verify P&IDs as part of a capital project anyway, why not just wait until you have a capital project? Because verifying accurate P&IDs does not take nearly the time as verifying, marking up, correcting, and re-verifying inaccurate P&IDs. Who has ever worked on a capital project where time was NOT a factor? Schedules are always tight for capital projects. Since you are spending the money to update P&IDs one way or the other, what is that TIME

worth on a project? Does it take 200 man hours to update during a capital project? What is that time in actual project schedule? A week? 2 weeks? How much is a week or 2 weeks of production worth? Then, there is the question of efficiency. Is it more efficient to update as changes are made or all at once. If P&IDs were updated as changes were made, would 200 man hours be 100 man hours instead? 50 perhaps?

Operating Costs

In addition to the cost impact on capital projects, you also forgo the benefits of having up-to-date P&IDs on operating costs if you only update for capital projects. These costs can be quantified too, though they are indirect and not always seen as a result of not updating P&IDs.

Have you ever encountered these issues in your operations?

- Why are we using so much fresh water?
- Why are our stock yields so low?
- The (fill-in-the-blank) has become a bottleneck. Why?
- Why does this tank /chest keep overflowing?
- Why has our chemical usage increased?
- Why is our steam consumption/condensate return so high/low?

Have you ever had to do a study or task force to answer these questions? If yes, what were the states of the P&IDs of the systems in question? Could you turn to your P&IDs and find an explanation? Was there one person on the task force that knew the entire process, or did everyone know "a little bit" of "this" portion or "that" portion? After your study, did you find some aspect of the process that was responsible that was not represented on the P&IDs that caught the team by surprise?

If you answered "yes" to those questions, then THAT is the cost of out-of-date P&IDs. The operating costs forgone and the time and energy spent identifying the problems. Had the P&IDs been updated as the process changed, perhaps that "emergency" tie-in to the fresh water system would not have become permanent. Or, the tie in would have been identified during a simple review of the P&ID by the engineering team. Keeping the P&IDs up-to-date means keeping the mill personnel's understanding of the process itself up-to-date! It means not having to have been onsite and seeing the change made, or having to work in that area to know the change was made.

Keeping P&IDs up-to-date means catching problems before they occur, or letting anyone with access to the P&IDs easily troubleshoot problems.

Additional Benefits

- Reduce "compartmentalization" of knowledge i.e. – Dick knows stock prep. Jane knows the wet-end.
- Allow for continuous optimization
- Training new employees
- A resource for vendors

And something worth additional discussion:

- Current CAD programs have features that can be useful for other mill procedures such as valve lists, instruments lists, maintenance files, etc.

More than Lines, Circles and Text on Paper

Modern CAD programs have abilities beyond just drafting. Even the most basic programs, the programs not designed to tie in to other piping and electrical (Smart) programs, have the ability to store and export data. This is a significant, yet overlooked capability.

Basic P&IDs

Every existing digital drawing or CAD (Computer Aided Design) file has capabilities beyond the printed copy usually kept in a flat file. These CAD P&ID files can store and export information depending on how the CAD P&IDs were created. The mill could build this data file to contain any information they wanted to have on hand in the form of a list. Things such as valve lists, complete with labels and sizes, line lists with line numbers, and associated specification and insulation information.

Using Instruments as an example, you may have the data file include:

- Instrument Number
- Instrument Name
- Instrument Type
- Manufacturer / Model
- Instrument Set Point
- Instrument Range
- Date of Last Calibration

The labels themselves, appearing as simple text, can be data, extracted and cataloged outside of the CAD Program. Taking AutoCAD as an example, you would use "Attributes" to identify any piece of equipment for which you wanted to track information. When AutoCAD is open, or when the drawing is printed, the Attribute would appear as normal text. However, when AutoCAD is running and you select the text, a dialog box would open revealing the data stored in the Attribute file. This data can be visible on the drawing, or hidden if it is not essential to the drawing itself. In AutoCAD, a LISP routine is a program language written inside the AutoCAD system itself (AutoLISP), which can be used to look for specific properties of elements for each CAD drawing. Given a unique LISP routine, written to extract this information, the task of populating a spreadsheet would be fairly automated. Utilizing this information extraction would by itself mostly eliminate the human factor of accidental error associated with manual data population. Single Point of Information Entry, or SPiE, would be the ultimate goal, using the P&ID itself as the single entry point. This means that to update any list, you MUST update the P&IDs. Updating P&IDs ENSURES that any lists match the P&IDs. If you use these data files for pumps, motors, equipment, instruments, valves, etc., it helps to enforce the discipline needed to keep P&IDs up-to-date.

Smart P&IDs

"Smart" CAD programs are drafting programs that utilize a database to tie-in and transfer information to other drafting programs for piping, electrical, and instrumentation. A CAD program which would generate "Smart" P&IDs would further utilize a SPiE or Single Point of Information Entry. As an example, a valve symbol could contain information such as size, manufacturer, descriptions of seat / bonnets / body, and shipping weight. Once this information is entered in the database, it can be reused in other applicable places in the project. Information attached to the components is transferred and used via the database in modeling software, showing their actual location in the mill. For construction, predetermined descriptions entered into the database are shown in the bill of materials of generated isometric drawings. Orthographic drawings can also show attributed information from the database. Line numbers, equipment numbers, etc. can be automatically updated in the attached programs once the Smart P&ID is updated or changed. This is one of the many benefits of utilizing Single Point of Information Entry.

Detailed information contained in a project database, used where needed, could, at turnover point, be used in many different places for operations and maintenance. This database, capturing the information added to the Smart P&IDs during mill expansion projects, would update in real time. This would eliminate the need for rework of future projects and provide a solid platform on which to base future system studies.

Beyond Lists - Maintenance Scheduling Benefits

Imagine, as part of your list, having maintenance history. Something as simple as a date of the last time it was maintained can serve as a reminder for maintenance items with extended service times. Items sometimes forgotten

because “they are working right now and have been for a while”. The scheduling of preventive maintenance alone could save valuable time and money by avoiding unexpected down time.

Another advantage would be tracking maintenance over time. Downward trends in component longevity could be an indicator of process inadequacies or future equipment failure. Frequency of valve maintenance or replacement could also indicate services requiring a different type of valve, gasket, or seat. Identifying and accessing these items could also yield a more productive process and less money spent on maintenance overall.

How Do You Get There from Here?

You have decided that updated P&IDs are a good idea. You are convinced that they will save you time and money on capital projects and allow you to keep your mill optimized and troubleshoot problems more easily should they arise. Your current P&IDs are… a mess. What do you do now? You can approach P&ID upgrades in one of two ways: piecemeal or all-at-once. Then, once you have completed the updates, how do you maintain their accuracy for the life of the mill? The short answer, procedure and policy enforced by mill leadership.

Updating

Piecemeal would be updating P&IDs when you do individual capital projects or optimization and troubleshooting projects. The one difference from the way this may normally be done would be to update the ENTIRE P&ID as opposed to just the items that are involved with the project or study. You should figure this when you set your budget and schedule for these projects. Include a little additional time and money to update P&IDs for processes that may not be completely included in the current scope. While this allows you to spread the cost of updating the P&IDs out over many projects, it also extends the time that it will take you to have accurate P&IDs.

The second way would be a project where the scope is the updating of the P&IDs. To this end, you can contract with an engineering firm or do the project with in-house resources. Updating P&IDs is routine to an engineering firm. They will have qualified Process Designers in-house with experience laying out and drawing legible P&IDs. They will have recent versions of the software optimized with tools to turn drawings around quickly. Engineering companies, such as Jedson Engineering, can use your company’s standards, typical industry standards, or work with you to develop standards of your own.

The work of tracing lines and running down information could be done with mill personnel, even if you need to contract with a qualified CAD Operator. This is a great project for Co-Ops or new hires. There is no better way to learn a system than walking it down, pipe by pipe.

Maintaining

This is the key to it all. All P&IDs start off as accurate. Perhaps you just spent a great deal of time and money making them accurate again. How do you keep them accurate?

1. Ownership
2. Procedure
3. Leadership

Ownership

Who exactly owns which P&IDs is not nearly as important as someone owning them. They can be owned by one person in one department, such as the Process Engineering Manager, or one person in each of two departments. For example, the Stock Prep Superintendent owns the Stock Prep P&IDs while the PM Superintendent owns the PM P&IDs. The key is knowing that when a change is made everyone knows to whom they must go to notify of the change. The person responsible for the P&IDs must then know how to make the modifications, which documents need to be updated, replace the necessary documents, and let engineering, maintenance, production, etc. know of the updates.

Procedure

As with Ownership, Procedure can vary depending on what works for each individual mill. Some aspects of Procedure are key however.

One key Procedure is creation of the Master Sets. The Masters are the "official" set. This represents the latest and greatest revision. This is the set that is "owned" by the person designated to make any updates. There will be three Master Sets:

1. The Electronic File – This Master Set will be in a secure location accessible to the Owner and any designee of the owner. This set is modified only with approval of the Owner.
2. The Print File – This Master Set will be in a network location accessible to any who have reason to print for personal use. These will be PDF versions of the Electronic File.
3. The Hard Copy – This Master set will be a printed set that resides with the owner. This set will be a print of the Electronic File, but also may contain markups, changes that have been made awaiting update of the Electronic File. When people print a set for personal use, they can check them against the Hard Copy and see if there have been any changes.

These Master Sets refer not only to the drawings, but any list generated by the drawings as well.

The second key procedure regards markups to the Hard Copy set. It is unlikely that everyone in the mill has the authority to make changes to the process as they see fit. Somewhere there is someone with the authority to authorize changes to any particular system. Whichever person has the authority to authorize a change, and then authorizes a change, also has the responsibility to markup that change on a personal set of P&IDs. They must then make sure they notify the Owner of that P&ID, who will verify the change and mark up the Hard Copy appropriately.

Frequency of the updates is up to the mill. It is unnecessary to make changes to the Electronic Master after each and every change, no matter how small. A time frame of once a quarter, once every 6 months, or even yearly, if changes are not that frequent, could be utilized. Of course, if there is a significant change, it may be wise to update immediately.

Leadership

This must become important to leadership in the mill. They have to set the expectation that P&IDs will be maintained. They have to make it part of the job. Something that employees are expected to do as part of their everyday responsibilities. They should show the employees the value and explain how this portion of the job makes it easier, in the long run, to make paper. If leadership does not take this work seriously and does not enforce policy, it will fail.

Conclusion

The benefits of updated P&IDs affect the bottom line, directly and indirectly. Keeping accurate P&IDs up-to-date is not difficult. It is much more a matter of will than effort, as the effort is small when done as changes are made. With practical Ownership, smart Procedure, and effective Leadership any mill can keep their P&IDs up to date and reap those benefits.

If you are unsure of how to proceed or have questions regarding CAD operating systems and their capabilities, please contact Doug or David at the Jedson Engineering office in Savannah or Cincinnati.

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