INTRODUCTION

1.1 Overview:

A digital twin is a virtual model designed to accurately reflect a physical object. The object being studied—for example, a wind turbine—is outfitted with various sensors related to vital areas of functionality. These sensors produce data about different aspects of the physical object's performance, such as energy output, temperature, weather conditions and more. This data is then relayed to a processing system and applied to the digital copy.

Once informed with such data, the virtual model can be used to run simulations, study performance issues and generate possible improvements, all with the goal of generating valuable insights—which can then be applied back to the original physical object.

Although simulations and digital twins both utilize digital models to replicate a system's various processes, a digital twin is actually a virtual environment, which makes it considerably richer for study. The difference between digital twin and simulation is largely a matter of scale: While a simulation typically studies one particular process, a digital twin can itself run any number of useful simulations in order to study multiple processes.

The differences don't end there. For example, simulations usually don't benefit from having real-time data. But digital twins are designed around a two-way flow of information that first occurs when object sensors provide relevant data to the system processor and then happens again when insights created by the processor are shared back with the original source object.

By having better and constantly updated data related to a wide range of areas, combined with the added computing power that accompanies a virtual environment, digital twins are able to study more issues from far more vantage points than standard simulations can—with greater ultimate potential to improve products and processes.

here are various types of digital twins depending on the level of product magnification. The biggest difference between these twins is the area of application. It is common to have different types of digital twins co-exist within a system or process.

1.2 Purpose:

Digital twins are used across the whole manufacturing lifecycle, from designing and planning to maintaining existing facilities. A digital twin prototype allows you to monitor your equipment at all times and analyze performance data that shows how a particular part or the entirety of your plant is functioning.

A Process Flow Diagram has multiple purposes: To document a process for better understanding, quality control and training of employees. To standardize a process for optimal efficiency and repeatability. To study a process for efficiency and improvement.

piping and instrumentation diagram (P&ID) is defined as follows: A diagram which shows the interconnection of process equipment and the instrumentation used to control the process. In the process industry, a standard set of symbols is used to prepare drawings of processes.

P&IDs are a schematic illustration of the functional relationship of piping, instrumentation and system equipment components used in the field of instrumentation and control or automation. They are typically created by engineers who are designing a manufacturing process for a physical plant.

These facilities usually require complex chemical or mechanical steps that are mapped out with P&IDs to construct a plant and also to maintain plant safety as a reference for Process Safety Information (PSI) in Process Safety Management (PSM). If something does go wrong, reviewing the P&ID is usually a good place to start. P&IDs are invaluable documents to keep on hand, whether they're used to streamline an existing process, replace a piece of equipment, or guide the design and implementation of a new facility. With the record they provide, changes can be planned safely and effectively using Management of Change (MOC).

2 PROBLEM DEFINITION AND DESIGN THINKING

2.1:Objective:

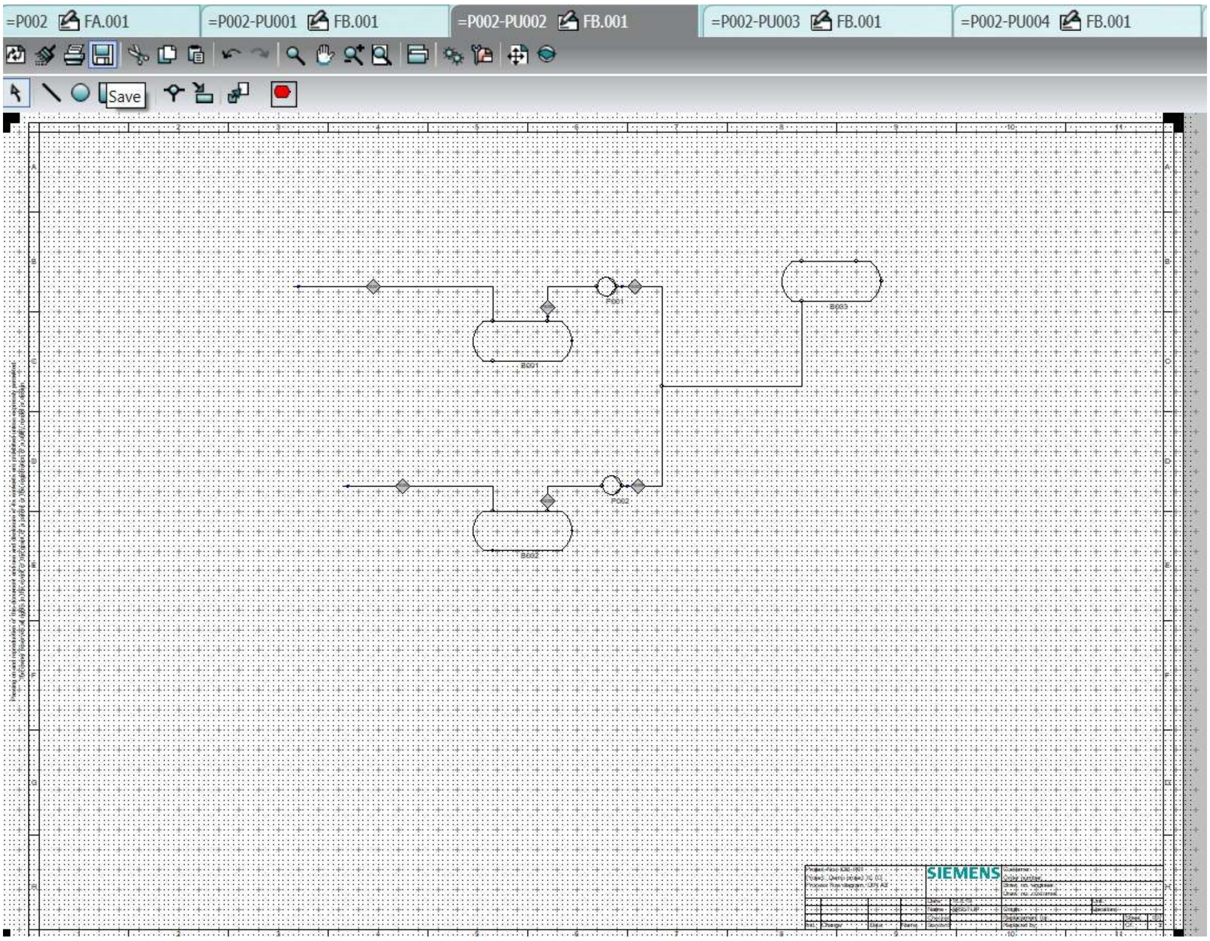
To get the more knowledge in the creation of Process Flow Diagram and Piping and Instrumentation Diagram of an process station to know the valve of using the COMOS are understand. The PFD is a schematic representation of the total production process. PIDs provide a detailed schematic representation of the connectivity/network between all equipment, fittings, pipes, valves, and instruments. More specifically they identify all equipment and characterize (size, materials & type) and sequence all pipe, pipe fittings, valves and in-line instrumentation. They also incorporate the plant control and operating philosophy and hence are the foundation documents for all HAZOP processes.

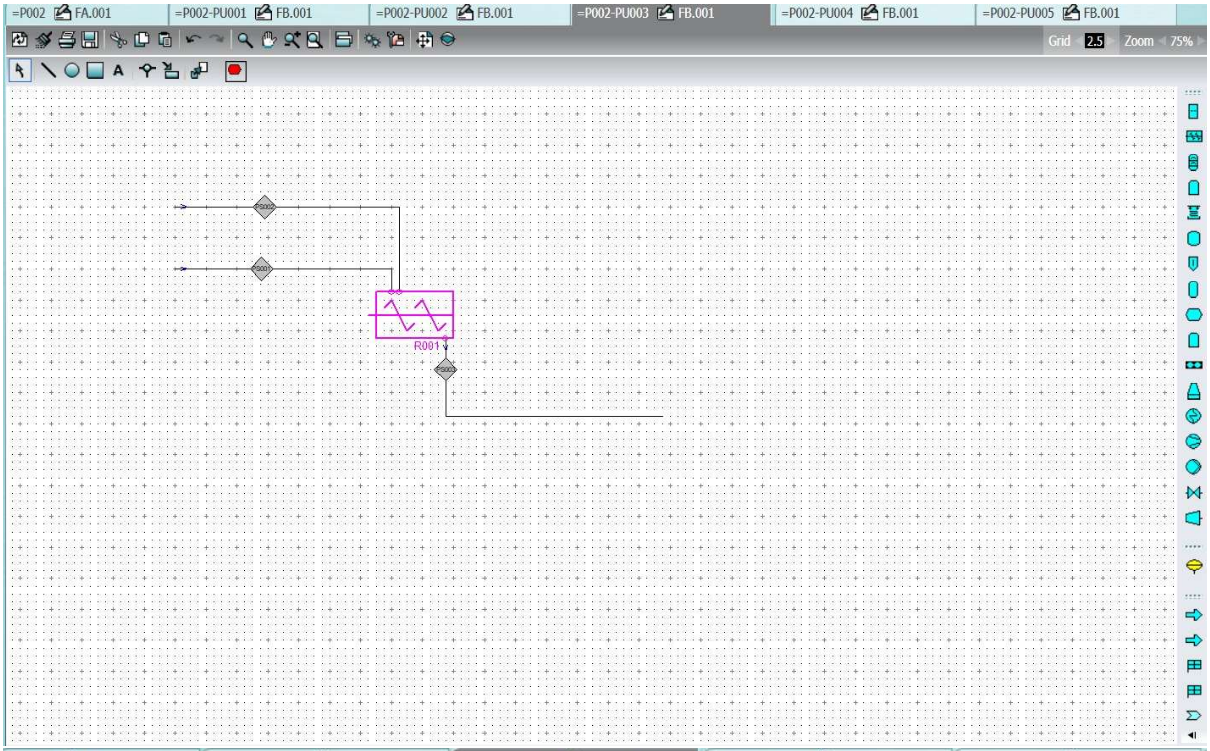
Generally, there is a clear distinction between PFDs and PIDs:

- PFDs are the foundation control documents for the process design, incorporating the mass, water, and energy balance.
- PIDs are the foundation control documents for engineering design.

2.2: Ideation and brainstorming:

PROCESS FLOW DIAGRAMS:

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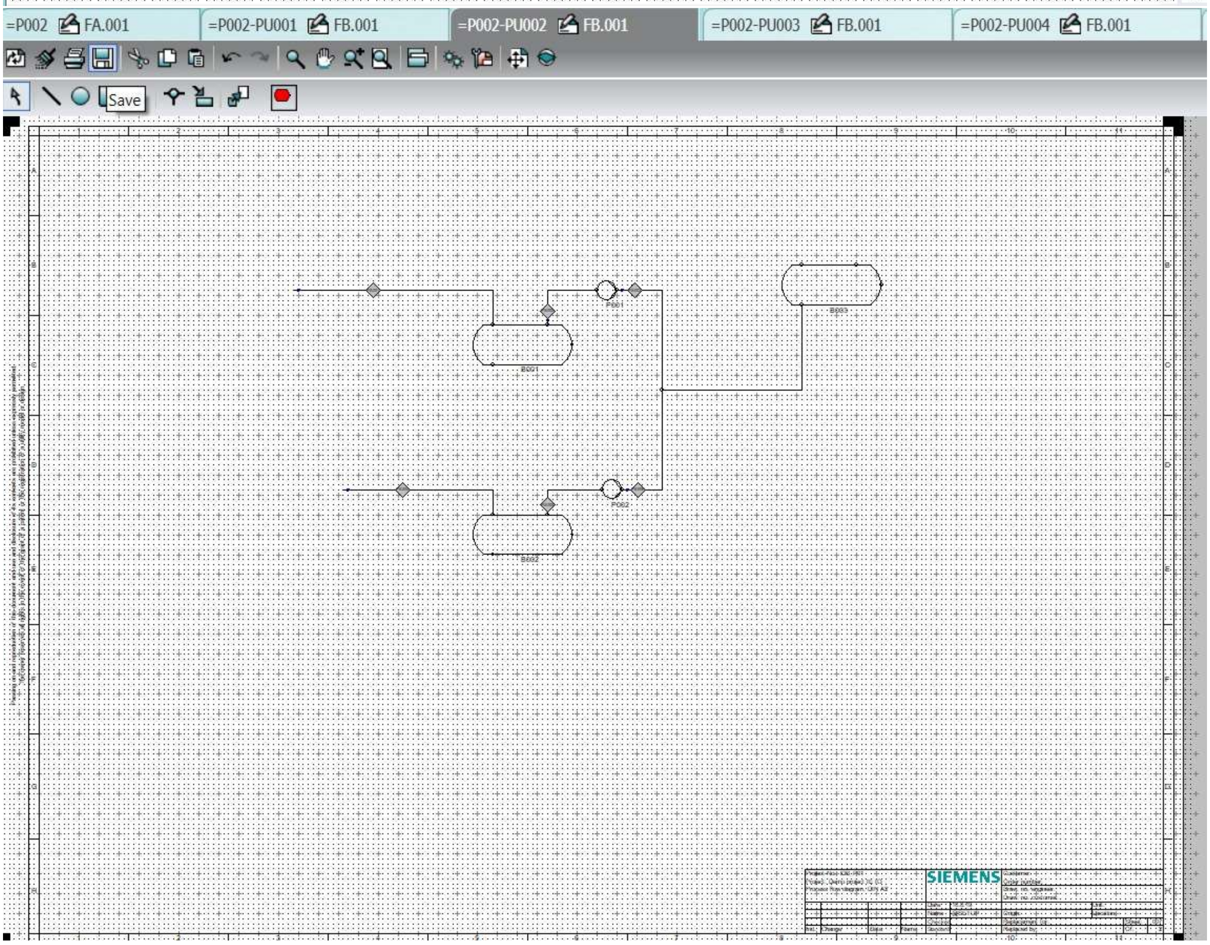
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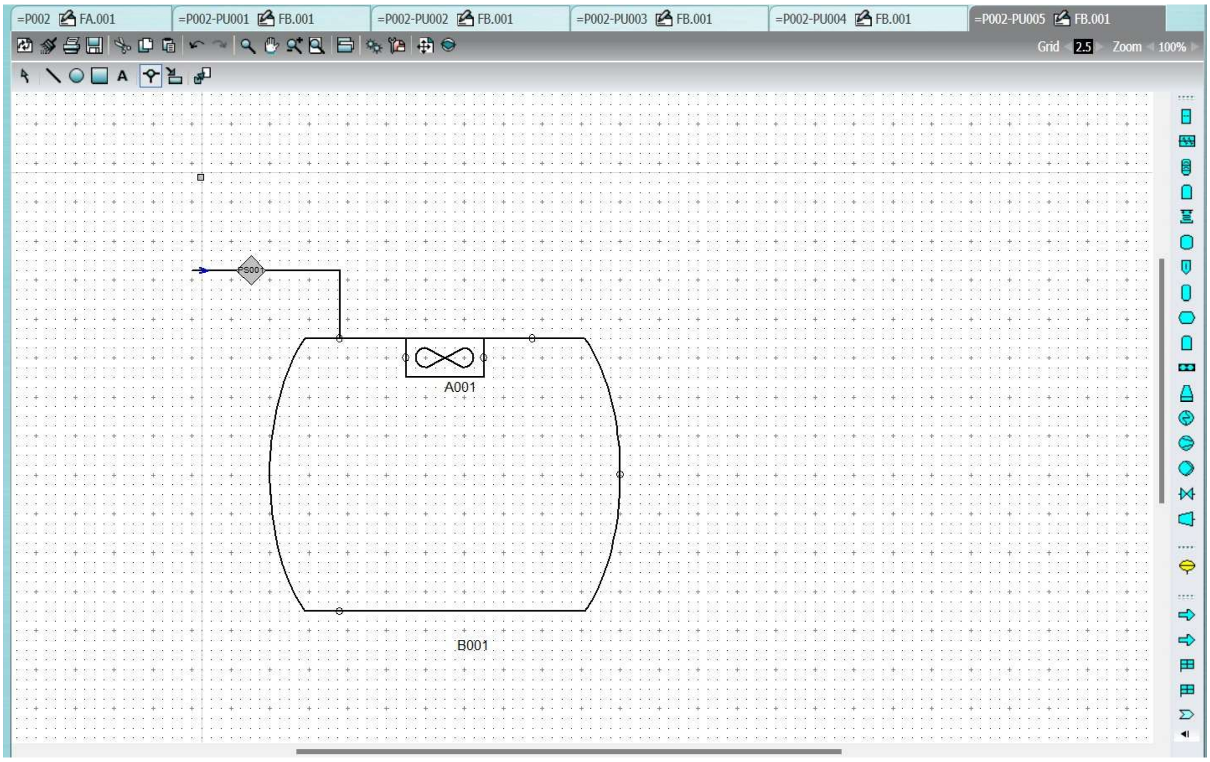
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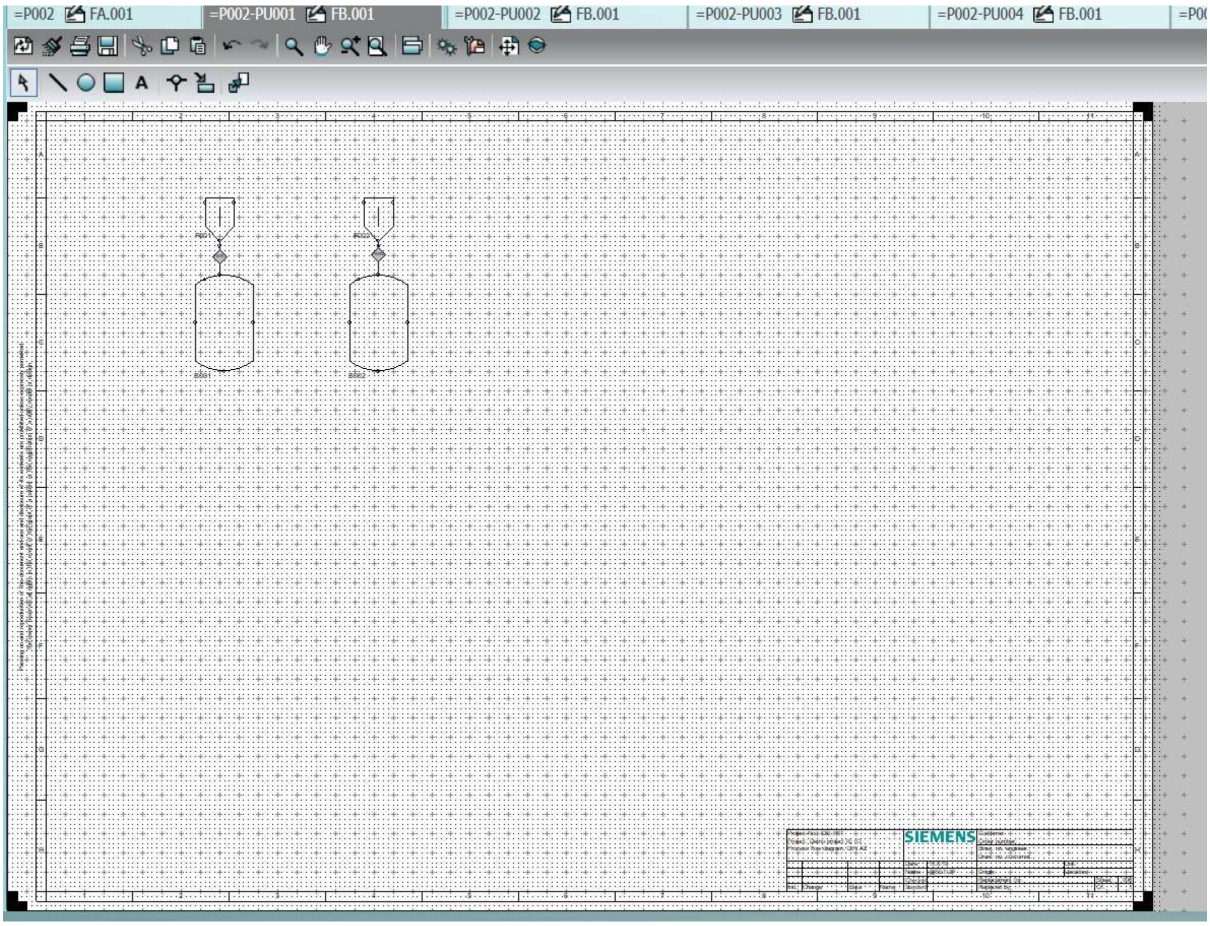
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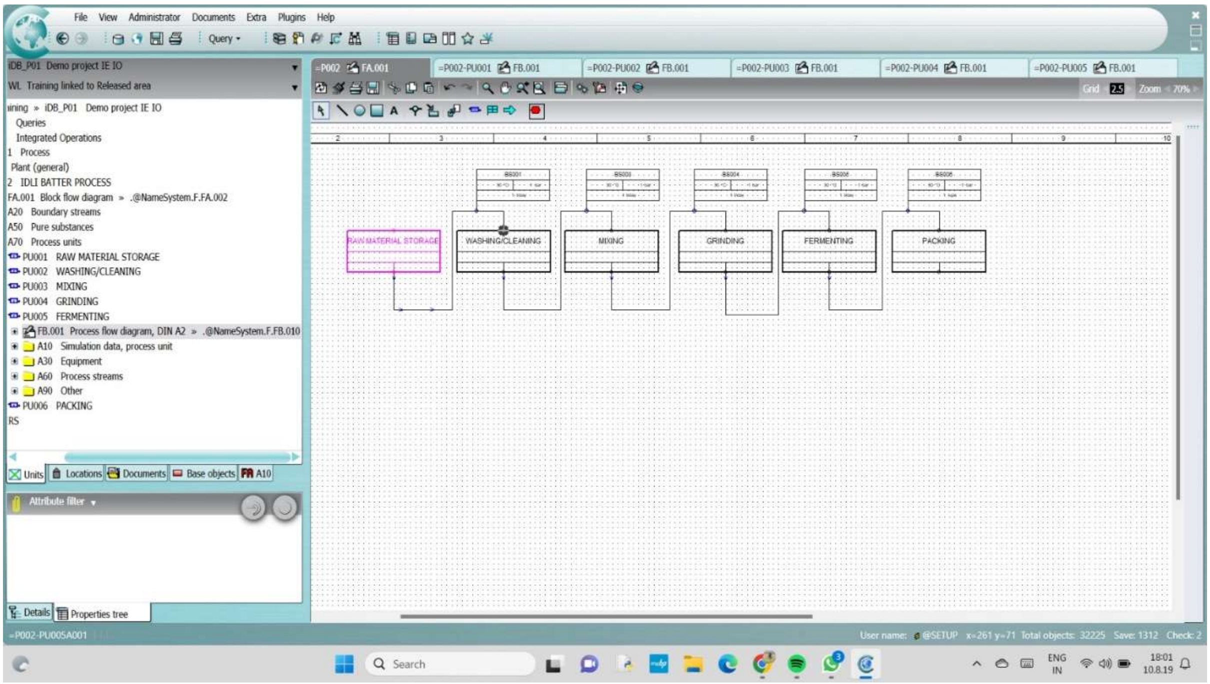
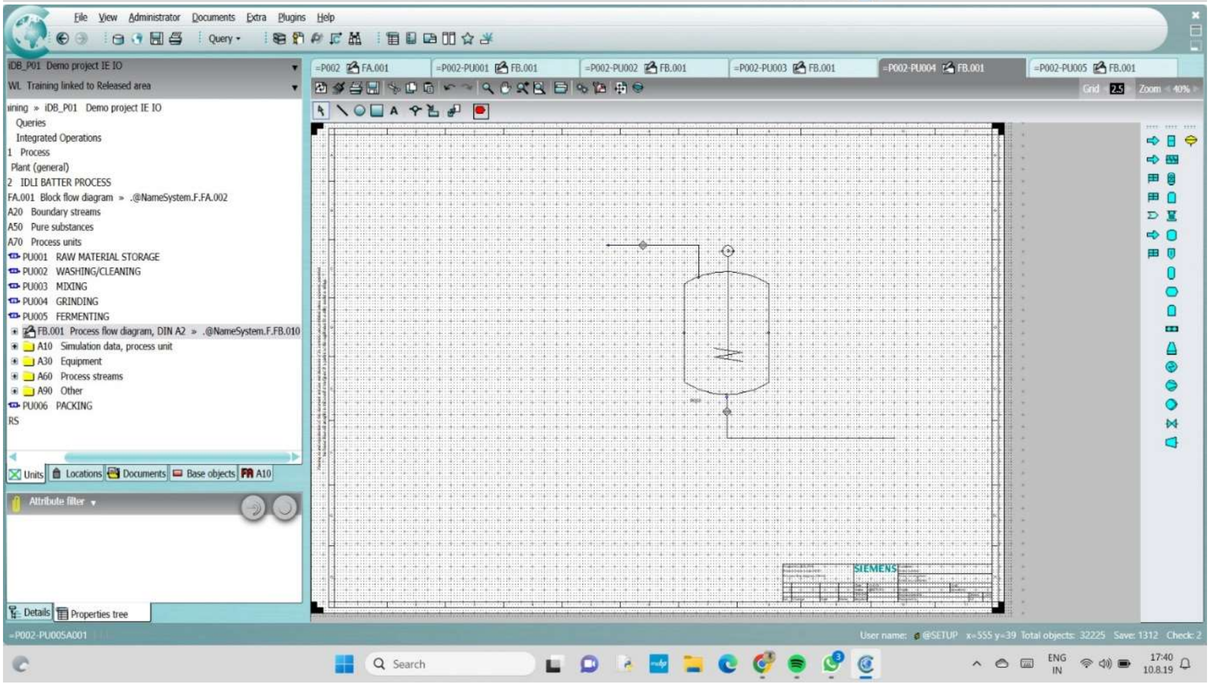
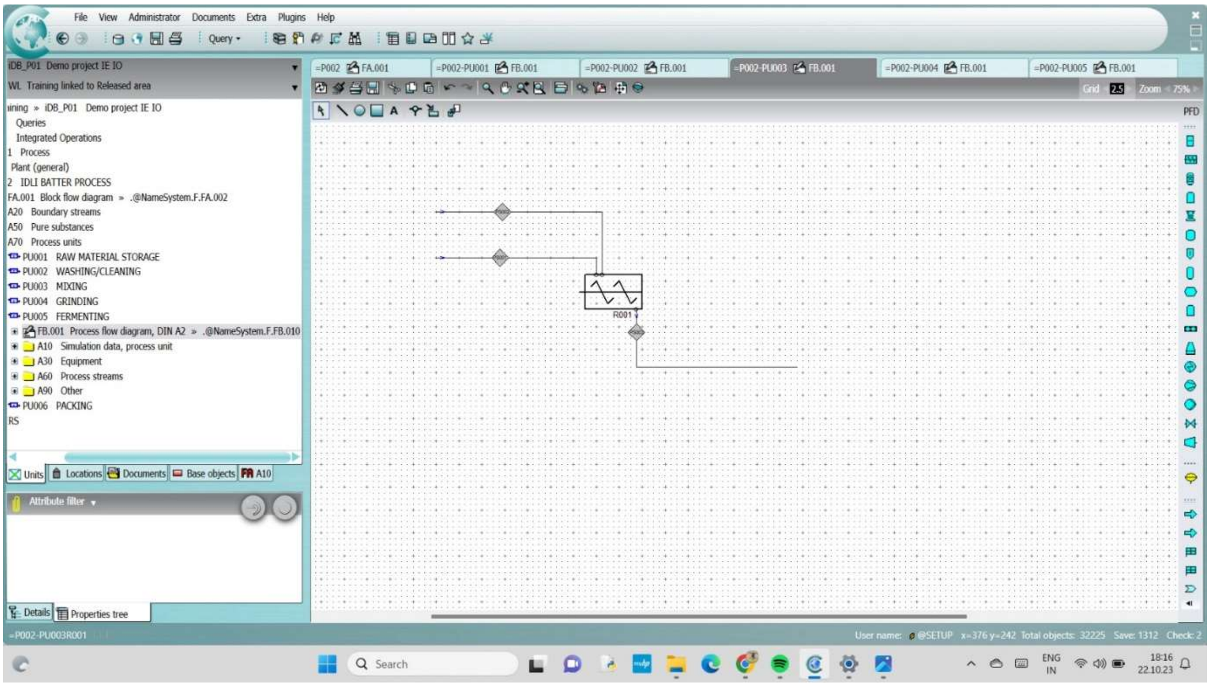
PIPING AND INSTRUMENTATION DIAGRAM:



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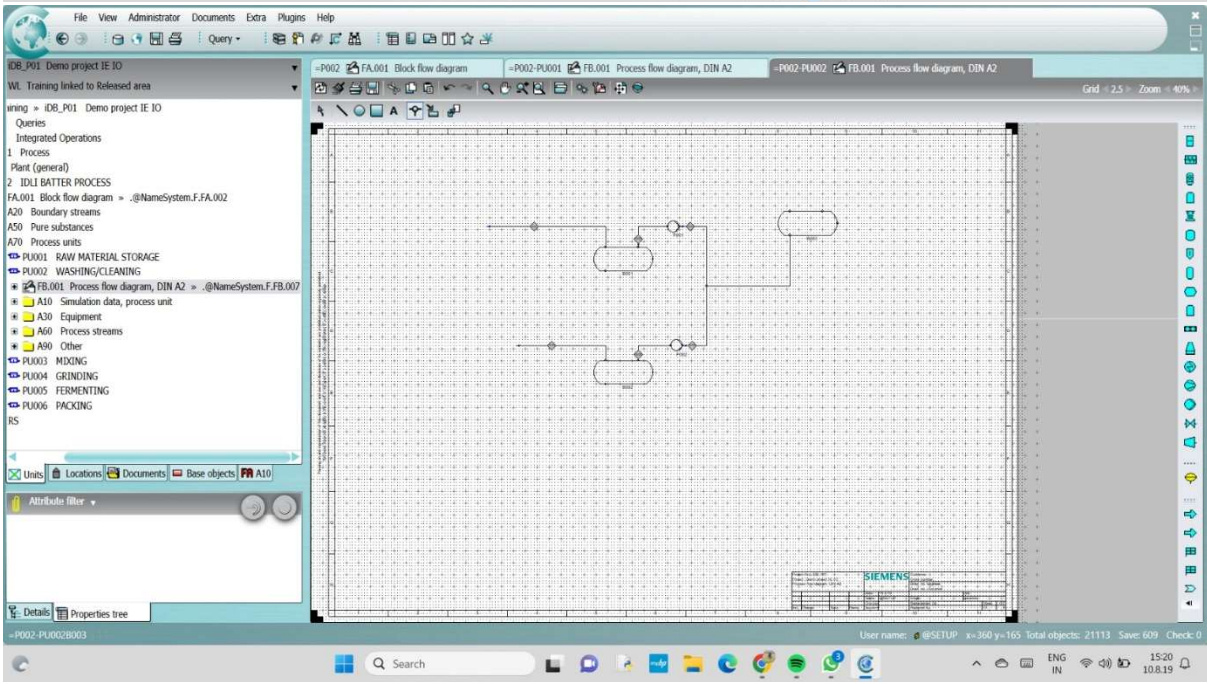
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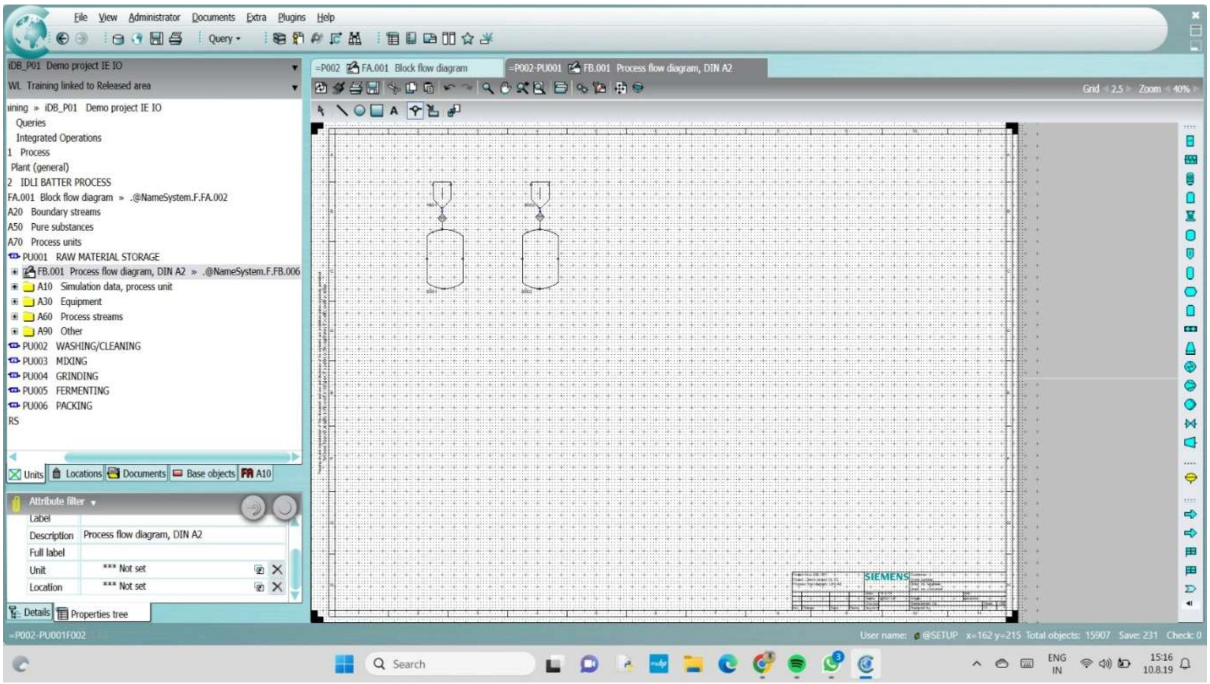

Result:

Thus the knowledge and understanding of the PFD and PID are obtained and applied successfully in the COSMOS software.

Advantages:

Advantages of PFD:

- It enables easy and better communication.
- Helpful for the visualization of complicated procedures in a simplified manner.
- It helps to analyze the way of cost saving and time allocation.
- It helps to Analyze the way to improvement.
- This documentation of the process is useful for showing how processes work.
- Useful for eliminating the not required processes.

Disadvantages of PID:

- PID provides greater accuracy than simpler on/off controllers.

- The algorithm is more energy efficient.
- It isn’t heavy on hardware, so devices with PID controllers are mostly cheap.
- The algorithm can be implemented as analog electronics, digital electronics, and mechanical solutions. Today, engineers mostly use digital PID controllers, but there are also pneumatic, hydraulic, and mechanical PID controllers.
- The P, I, and D components can be tuned intuitively, by trial and error. Even if tuning the PID controller in a control system does require a specialist, one session should last for years.
- More advanced controllers will probably require stopping the process for re-tuning. But a universal PID controller can often be re-tuned while the process is still running, which is often more convenient.
- Unlike simpler solutions, the PID algorithm can substantially extend the life of an actuation device.
- While advanced controllers are more efficient, using them may not be worth the expense and effort.
- Unlike model-based controllers, the PID algorithm responds to unmeasured disturbances better due to having proportional and derivative actions.
- The PID algorithm has been in use for over 70 years, so engineers have found workarounds for many of the existing problems.

Disadvantages:

Disadvantages of PFD

- Flowcharts can be difficult when changes need to be made. It takes a lot of time and money to redraw the whole flowchart. This is the biggest downside of using flowcharts.
- When a process is complicated, it can be hard for the people in charge to understand. It might take too much time to figure out what is happening.
- Flowcharts do not allow you to type symbols. You must use other software like Word or Excel to make shapes and put words in them. This makes it hard to copy a flowchart since you need shapes.

Disadvantages of PID

- If not tuned properly, the algorithm can make the system unstable and even damage it.
- PID controllers amplify the high-frequency content of the error signal. This boosts the noise component of the control output, which destabilizes the system.
- The PID technique suits single input, single output (SISO) systems. But classic PID controllers don't do well if there's a need to control more than one parameter.
- The unmodified PID algorithm performs poorly when the delay between the output and the process response is too long. But the problem can be solved by augmenting the mechanism with additional intelligence.

Application:

PFDs serve as the initial tool used to create the specifications and data sheets for all the process related equipment; PIDs further enhance the specifications and data sheets. They initiate the definition of all piping, instrumentation, control valves, and electrical components.

- Process selection and optimisation.
- Process design criteria.
- Mass, water, and energy balances.
- Process stream characterization.
- High level process control philosophy and control system configuration.
- Preliminary equipment and motor lists.
- Equipment datasheets (process equipment but excluding piping and valves).
- Basis of preliminary HAZOP.
- Generation of P&IDs.
- Preliminary capital cost (Capex) estimating.

The uses of PIDs are listed as follows:

- Equipment list / motor list / instrument list generation.
- Equipment specifications and data sheets.
- Piping, valves, instrumentation, and hoses specifications/piping installation.
- Instrumentation equipment, controls, and loops.
- Architectural and HVAC (Heating, Ventilation and Air Conditioning).
- Final master line list/valve list.

- HAZOP’s.
- Capital cost estimating.
- Basis of master drawing register.
- Single Line Diagram (SLDs).

Conclusion:

In conclusion, PID and PFD is a vital element in process control and automation. It provides a clear understanding of the process, which helps in identifying issues, troubleshooting process failures, and designing efficient automation systems. Following the best practices in creating PID and PFD is crucial for accuracy and effective process control. By using P&ID, process engineers and automation professionals can design and optimize efficient processes that maximize productivity, reduce costs, and improve the quality of products.