Creating an online, Interactive, 3D Piping Layout application in Forge

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Clean Agent Fire Suppression System

- Detectors are the first line of action against fire
- After detection, a signal is sent to the control panel which sounds alarm, alert authorities and perform necessary action like closing the doors, shutting down power, etc.
- Control panel also initiate the release sequence
- System discharges, agent is distributed through nozzles suppressing the fire
- Pressurized gas or agent is used that either cools the hazard area or reduces oxygen conc. so that fire cannot sustain

https://www.youtube.com/watch?v=1nMf1cSAYrw

This recording demonstrates how a clean agent fire suppression system works

Clean Agent Fire Suppression System

- Clean agent fire suppression is based on total flooding principle

In a total flooding system, the extinguishing agent is distributed into the 3D space and, after having reached the desired minimum concentration suppresses the fire.

- What is clean agent?

It is an electronically non-conductive suppressant based either on inert gases or chemical agents.

- Where is it used?

Data / server rooms, art galleries, museums etc.

- Why is it used?

It is used in places where water-based/other foam-based substitutes may compound the damage.

Suppression Design Center

- The Suppression Design Center (SDC) is a web-based application developed to assist in the configuration and design of gaseous suppression systems, create a bill of materials and perform hydraulic calculations, all in one place.
- The application has been developed for fire suppression engineers, designers and distributors
- It is a WAMP stack application. WAMP → Windows Apache MySQL PHP
- Consists of two main modules
  - Estimator – Used to configure the system
  - Hydraulic Run Manager – Used to generate pipe data and perform Hydraulic calculation
- History – It started as an estimator tool to which calculation module was added later. First manual pipe entry was added as an input to calc engine and then 3D design was introduced.
- 3D design is achieved with Forge Viewer API, where we use it as a 3D canvas to draw on
- Mostly all the pages in SDC are based on logic tables, generated with knowledge of subject matter experts
- Data is the backbone to SDC everything is driven based on user input and results from calculation

Suppression Design Center

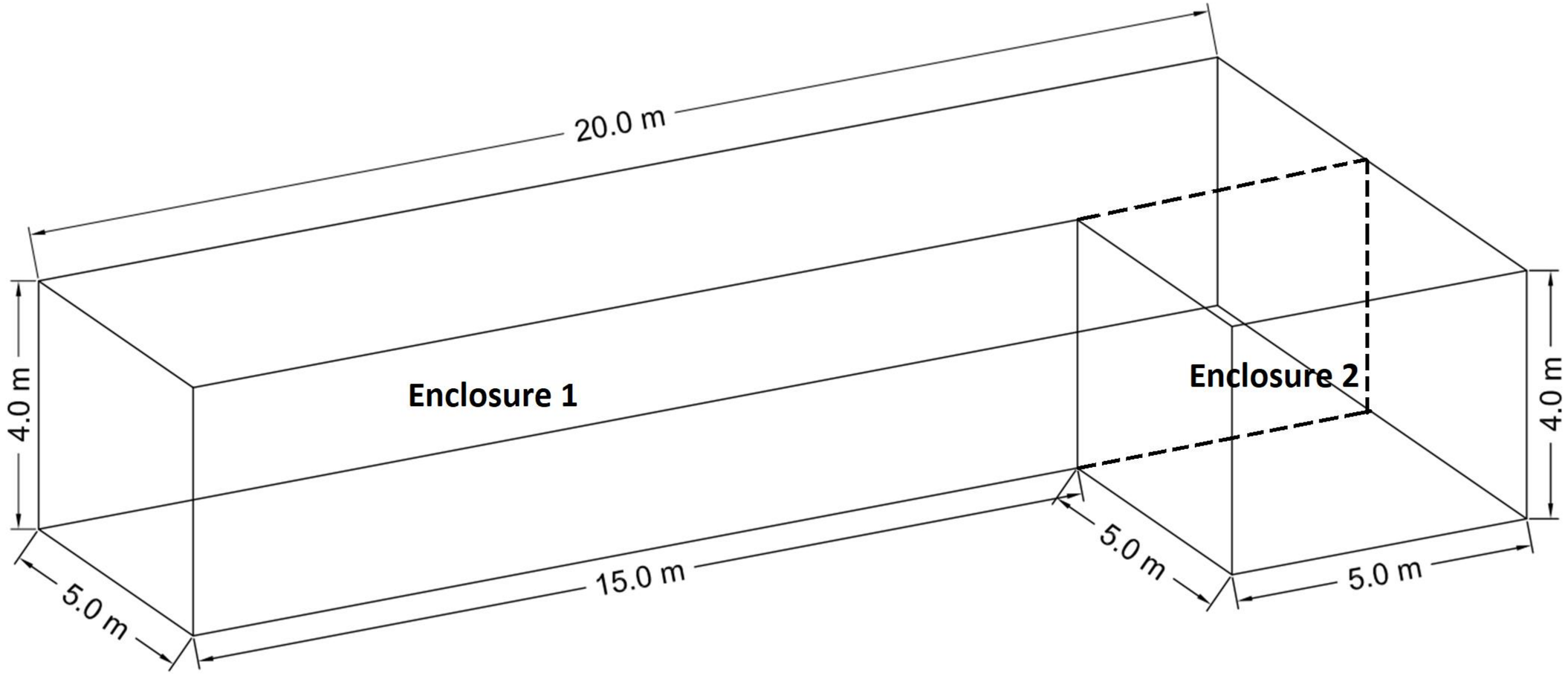
- Home / landing page for SDC
- Gives information about available systems
- Links to licensing, FAQs and contact us pages
- Licenses are allotted to company admins who can add users and control roles within a company
- First page is project management window
- A user can duplicate, delete, share, export and edit details within a project
- Clicking on + sign of a project a user can navigate to
    - Estimator
    - Hydraulic Calculation

https://www.youtube.com/watch?v=O_42-DF1HBU

This recording introduces SDC, the landing page, project management window and options

Section Break

Example Case – Hazard Description



Example Case – Hazard Description

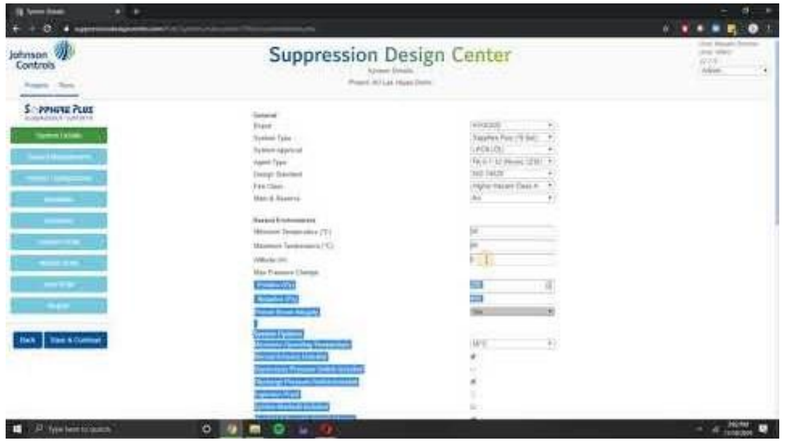
- Hazard is an L – shaped room which is divided into two smaller enclosures 1 and 2. Dimensions
  - 20 L x 5 W x 4 H
  - 5 L x 5 W x 4 H
- Design Standard: ISO 14520 – Higher Hazard Class A Fire
- Design Concentration = 5.6%
- Minimum Hazard Temperature = $20° C$
- Maximum Hazard Temperature = $40° C$
- Altitude = Sea Level
- Maximum positive pressure = 200 Pa
- Maximum negative pressure = 300 Pa

Estimating in SDC (10)

1. Configuration
    1. System Details
    2. Hazard Management
    3. System Configuration
    4. Manifolds
    5. Actuation
2. Editing Results
    1. System bill of material
    2. Nozzle bill of material
    3. Vent bill of material
3. Report

Estimating in SDC – Configuration – System Details

- The *System Details* page is where the core system options and parameters are chosen.
- This page consists of a series of dropdowns and numerical inputs that defines the type of system to use and the hazard environment
- Most important of them are
  - System approval
  - Design standard
  - Transport approval
  - Operating Temperature
- Others are configuration related, helps in guiding design

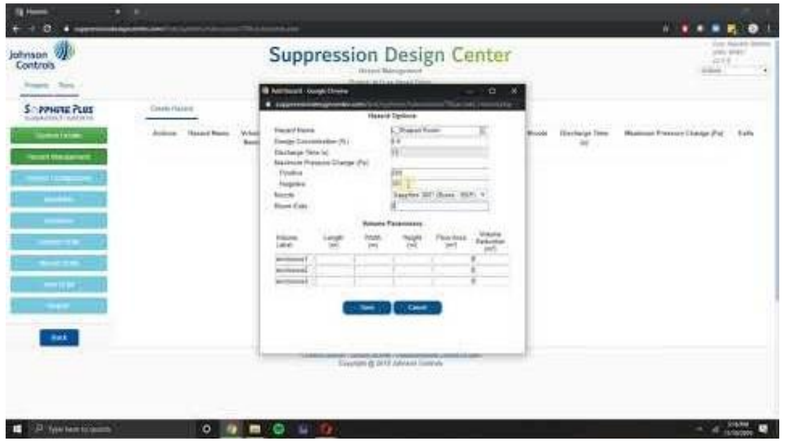


https://www.youtube.com/watch?v=zUzWX3Zu0dw

In this recording we enter the details regarding type of the system and hazard environment

Estimating in SDC – Configuration – Hazard Management

- This is where protected rooms / volumes are defined
- Volume information can be entered using either length, width and height or floor area and height
- Volume reductions are recorded if any
- Hazard specific information like
    - Number of exits
    - Nozzles
    - Wall strength
    - Design concentration
- A quick summary for number of nozzles and sizes is generated

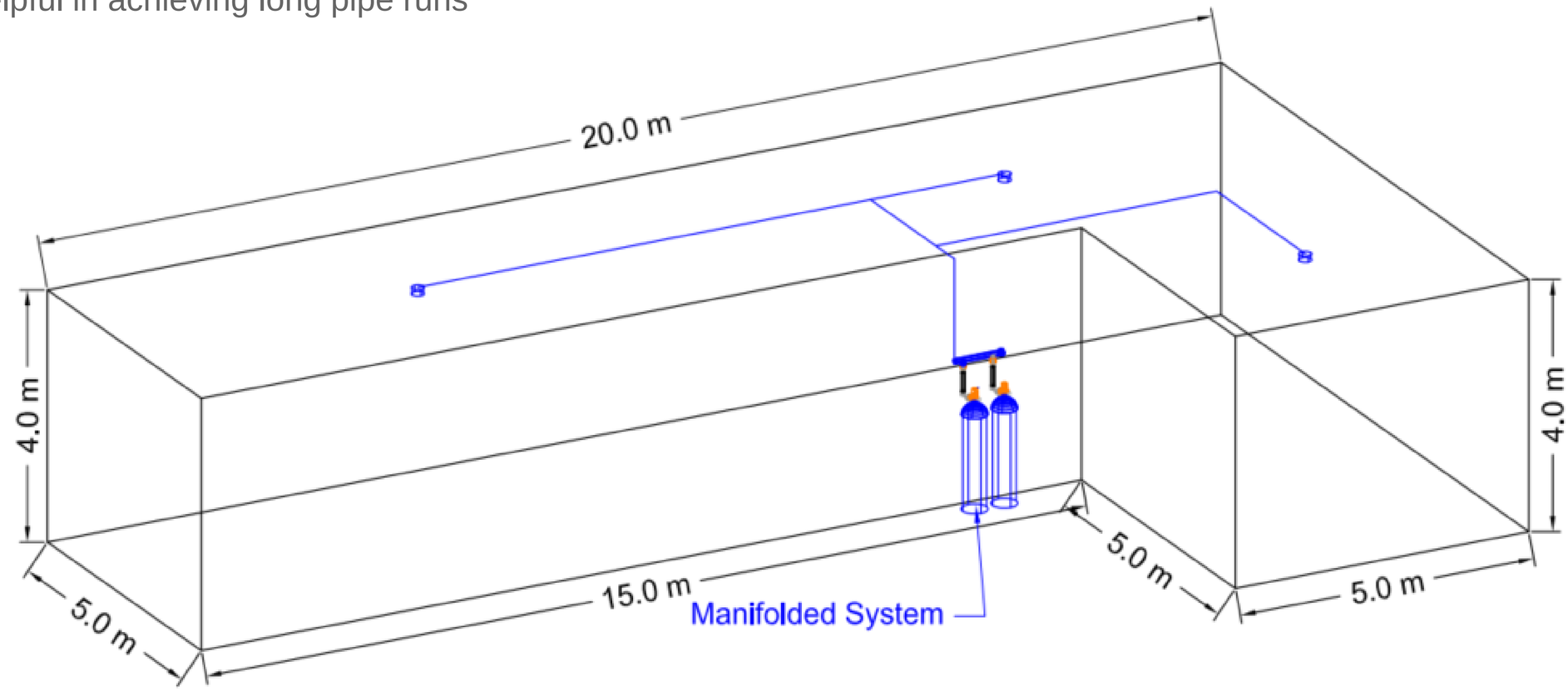


https://www.youtube.com/watch?v=bwapStl-bC0

In this recording we enter the Hazard details information and dimensions of the two enclosures to be protected

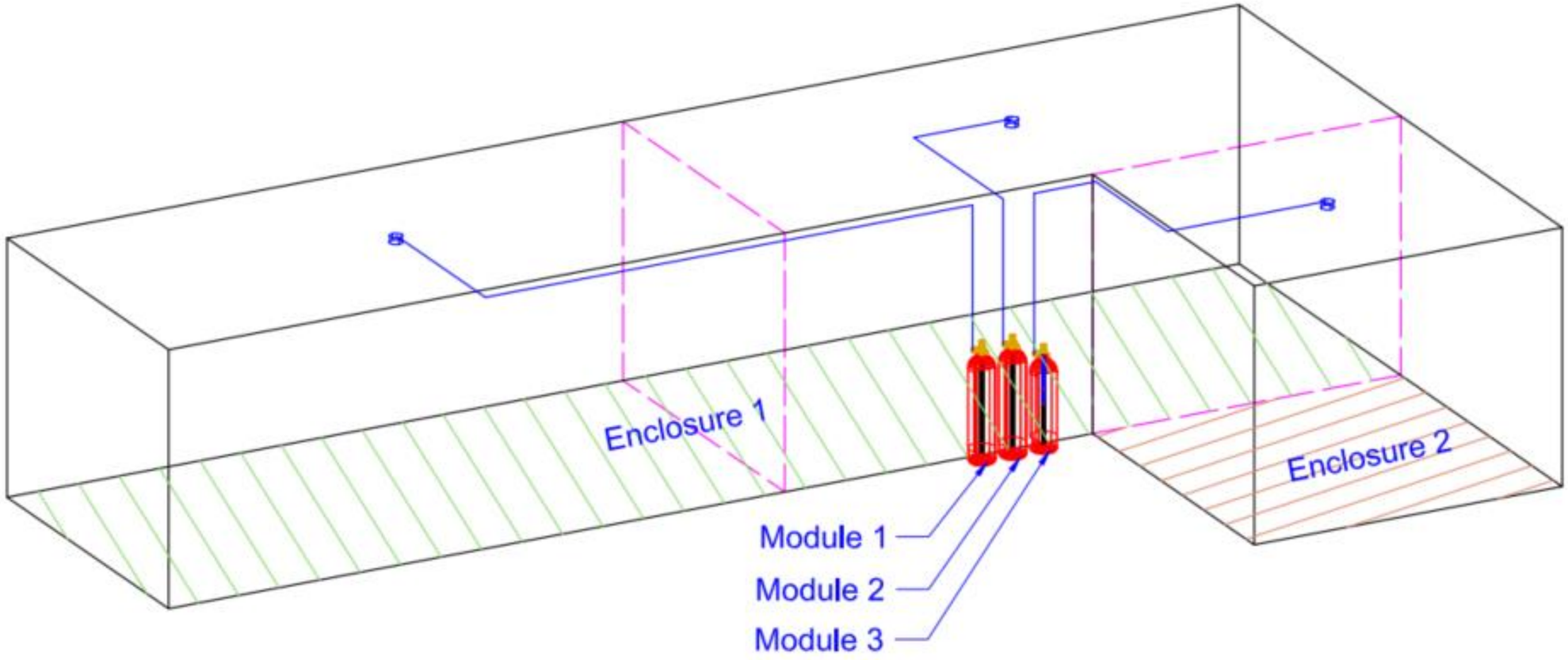
System Configuration – Manifolded

- Discharge from all the cylinders is combined into a single pipe and is then distributed
- Very helpful in achieving long pipe runs



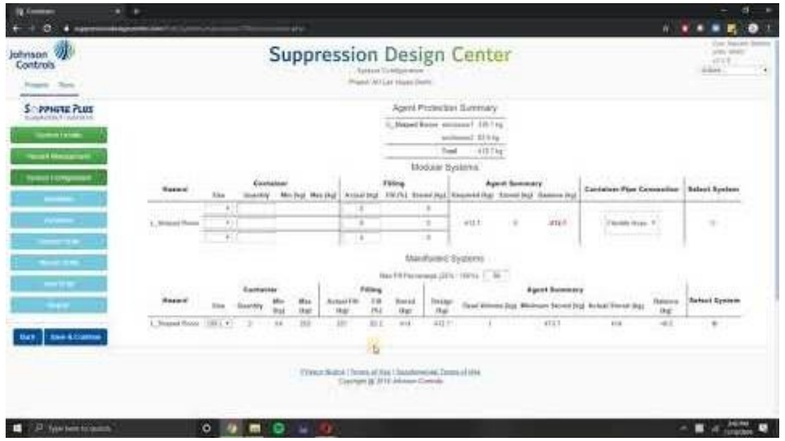
System Configuration – Modular

- Each cylinder discharge to a pre-determined area
- Good for smaller and very large systems (Modularizing saves from huge and heavy distribution piping



Estimating in SDC – Configuration – System Configuration

- Provides summary of
  - Total agent required and agent required per enclosure
  - Number of required containers per hazard for manifolded configuration
- Defaults to manifolded system
- Modules are added in the modular system section making sure the total design agent quantity is met. Also, additional nozzles are added so every nozzle have at least one discharge nozzle.



https://www.youtube.com/watch?v=PRWcsPJoUpk

This recording shows the offered configurations for a system type and a way to toggle between them

Estimating in SDC – Manifolds

- Dynamic Page, will appear or not based on selection for manifolded or modular configuration
- Pre-calculates the manifolds to be used based on port count → cylinder quantity
- Can be edited. Note: Final port count = cylinder quantity

https://www.youtube.com/watch?v=hBOa50lQjzc

This recording is to demonstrate the manifold selection page

Estimating in SDC – Actuation

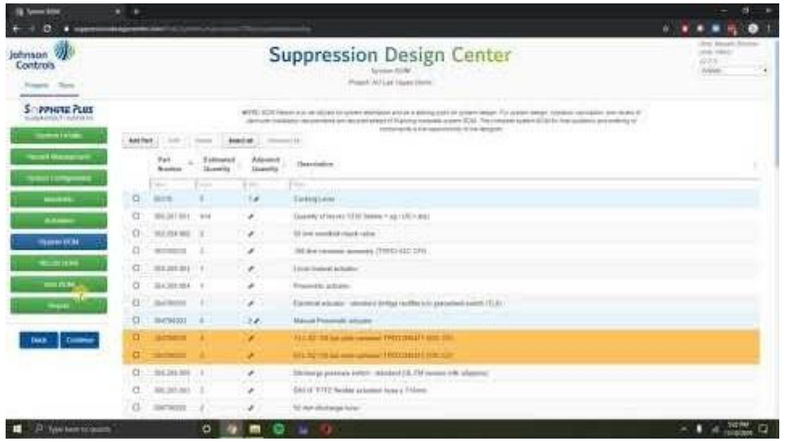
- A selection for type of actuation can be made from the available options;
  - Master-Subordinate (electric),
  - Pilot Container
  - Automan II C
- Actuation line type is also selected here:
  - Flexible Hose
  - Copper 6mm
  - Copper ¼”
- The options are made available based on approved combinations, ex Automan II and Electric
- The options are governed based on the logic tables

https://www.youtube.com/watch?v=_fCg_QAlvaU

In this recording we look at the different types of actuation options available to us for the current system and talk a little about the logic tables.

Estimating in SDC – Editing Results and Viewing Report

- System BoM
  - List parts required (white) and optional (yellow) with searchable fields is displayed
  - Parts can be added or removed
  - Parts can be sorted based on fields
- Nozzle BoM: A protection summary is provided with size, finish, type and quantity all of which can be modified.
- Vent BoM: A summary for required venting is provided with FVA made available by current selected part.
- Report: A report with all the inputs can be saved to a pdf, and a part list can be exported to local machine



https://www.youtube.com/watch?v=aajhgS6Yd7Q

In this recording we walk through the part lists generated for system, nozzle and vent, view how they can be modified, and optional parts can be added

Section Break

Hydraulic Run Manager (20)

1. Pre-editor
    1. Hydraulic Option
    2. Nozzle Configuration
    3. Container Bank Configurator
    4. Container Bank Edit
2. 3D Editor
    1. Looks, features & commands
    2. Components
    3. Drawing the Example
    4. Copy Example, Mirror Example
3. Post Editor
    1. Pipe Data
    2. Report

Hydraulic Run Manager – Hydraulic Options

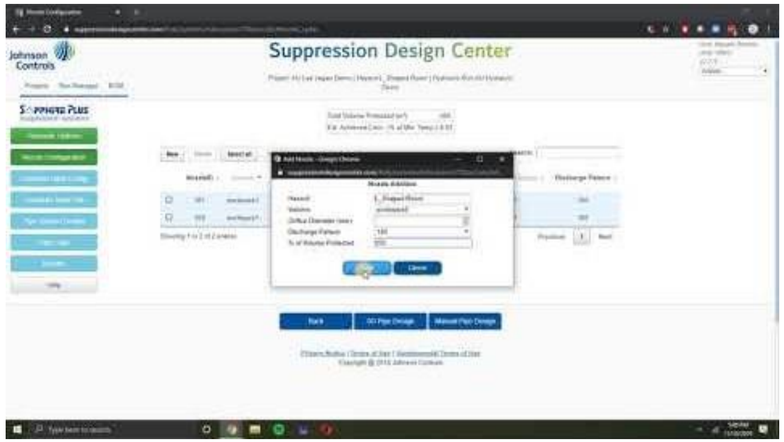
- Hydraulic Run Manager
  - Multiple hydraulic runs can be created per project
  - Separate runs are created for each hazard
- Hydraulic Options
  - Two types of nozzle specifications are possible
    - Agent quantity
    - Fixed orifice
  - Fields are prepopulated with configuration data
  - Values can be modified, ex. container quantity, discharge time, etc.

https://www.youtube.com/watch?v=-BUwAbFsiTc

This recording shows the management page for Hydraulic calculations, editing options for runs, and menu for hydraulic options page the first in line for 3D design.

Hydraulic Run Manager – Pre-3D

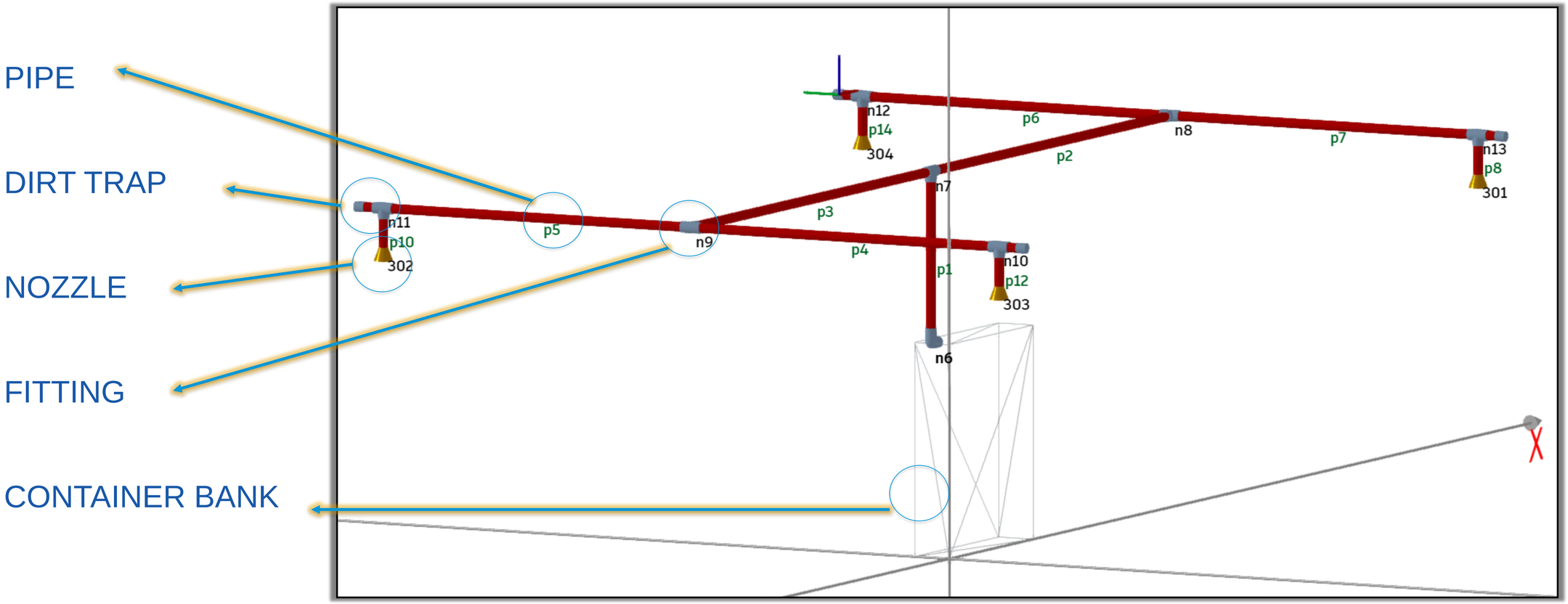
- Nozzle Configuration
  - Associate nozzles to each enclosure
  - Assign percentage of volume protected by each nozzle
  - If was fixed nozzle we would specify orifice size
- Container Bank Configurator
  - Select shape, schedule, and size for a manifold
  - Enter cylinders to left (only for center and U shapes)
- Container Bank Edit
  - Check and correct
  - For custom shapes modify, insert and delete entries



https://www.youtube.com/watch?v=lE7zsDUzpII

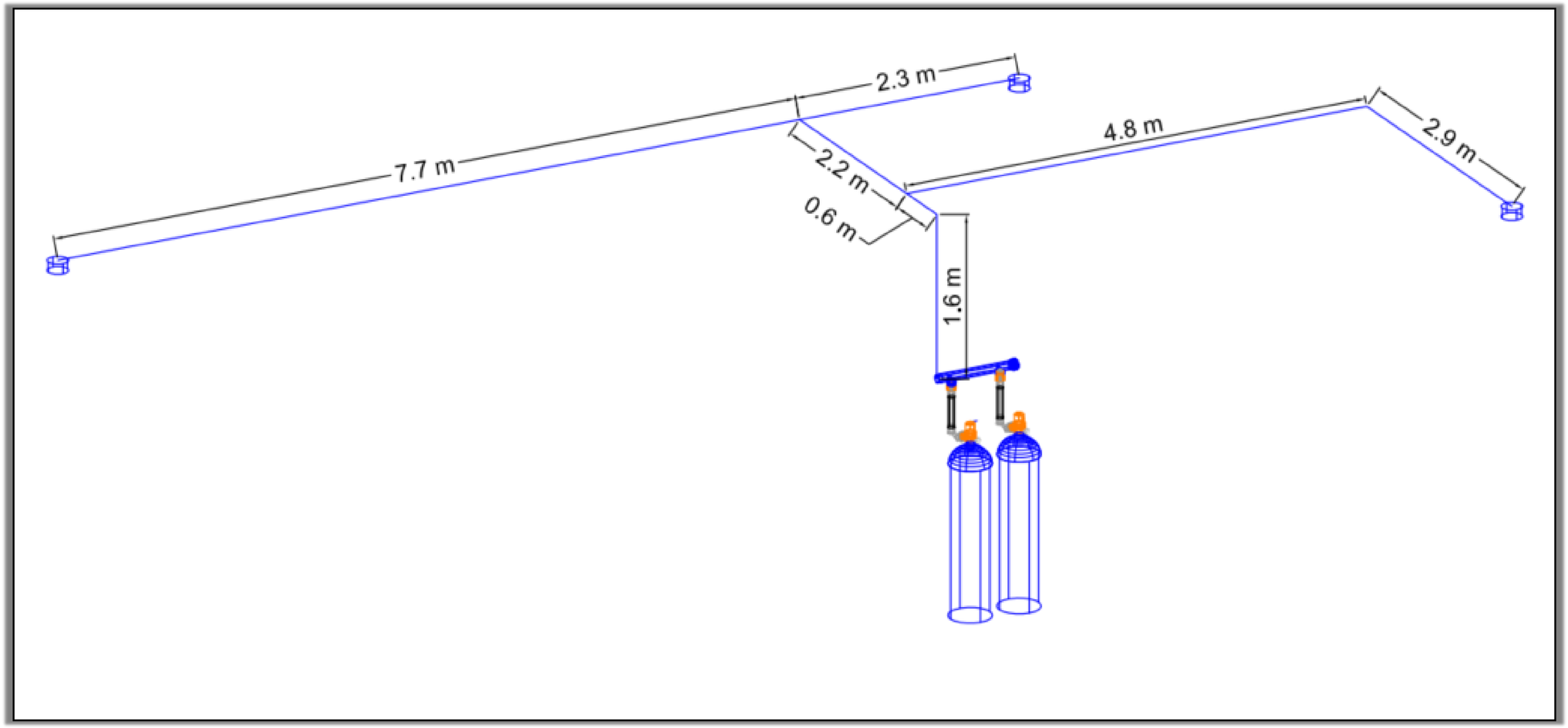
This recording demonstrates how to prepare nozzles to be drawn in 3D, choose a container arrangement and edit the sectional information if needed.

3D - Components



Schematic representation for drawing components with label.

3D drawing



Built in AutoCAD

Hydraulic Run Manager – 3D Design – Example

- Two menus Forge Viewer default and JCI custom
- Forge Viewer is used as a 3D canvas to draw on
- A plug-in which converts user input into graphical object &
  - Checks if all nozzles are assigned
  - Piping network is closed
  - All node points are connected
  - No multiple pipe in same direction with same origin
- Processing engine
  - Server-side Validation
  - Inserts right fittings, generates section for calculation module and tracks flow direction

https://www.youtube.com/watch?v=tGgJ3yloHhE

In this recording we focus on drawing in 3D, exploring features of the application and talk about how it is built.

Hydraulic Run Manager – 3D Design – Features

- Copy command
  - Select pipes
  - Select base node
  - Select destination node
- Mirror Command
  - Select pipes
  - Select plane for reflection
  - Select base node for reflection

https://www.youtube.com/watch?v=lO7IRsrU3zk

Touches upon two very important features of mirror and copy, developed specifically to accelerate the design process.

Hydraulic Run Manager – Pipe Data & Report

- Pipe Data page shows
  - Section information including fittings, lengths, pipe size, schedule, elevation, containers and discharge agent quantity (through each nozzle)
- Report
  - Shows achieved and design concentrations
  - Generates pipe size and nozzle drill diameter results
  - Displays sectional flow rate value and pressures
  - The actual discharge time
  - Free Vent Area for achieved concertation

https://www.youtube.com/watch?v=O2eRf6e5ikQ

In this recording we verify sectional information obtained after 3D drawing and submit inputs to calculation module for results.

Data in SDC

- SDC uses relational database
- There is three types of data tables in SDC broadly speaking
  - Logic tables → That drives choices
  - Project Information tables → Saves project information input as well as background calculation results
  - Bill of Material tables → Which contains part information and configuration logic
- Based on inputs we can control the entire workflow, fields, pages, etc.
- The most important aspect of acquiring as well as using the data from input to output is the sequence

Conclusion

- Advantages of internet
  - One platform of development
  - Quicker fixes and publishes
  - Easy to integrate with other applications

- Challenges for engineering companies;
  - Heavy memory needs on rendering
  - Identifying good platform for engineering development
  - Everything is on local

Conclusions

- How Forge can help
  - Forge lets user convert most traditional files immediately to a web viewable / editable project
  - From what we have seen you can collaborate with Autodesk and can even draw creating custom objects
  - There is Forge API to even manage data
  - Model derivatives can be downloaded back
  - Models with detailed BIM information is good for marketing / selling a product
  - Future of Forge for JCI
    - Include Revit models and draw on them (the reason for selecting Forge Viewer API over others)
    - Attach fabrication information with drawings and create submittal quality final product

- Drawbacks
  - Finding resources who knows how to develop within Forge Viewer AOI
  - It is free now but, it could be made into a paid service