



## Project Overview

- Purpose: provide an **integrated electrical design tool** within the ShipConstructor product model and relational database structure
- Shipboard Electrical Analysis – Production (**SEA-Pro**): ONR sponsored SBIR, NSRP PDMT Topic.
- **ShipConstructor Electrical Module**: NSRP Second Tier Shipyard Design Enhancement Program (STS DEP)



## SEA-Pro

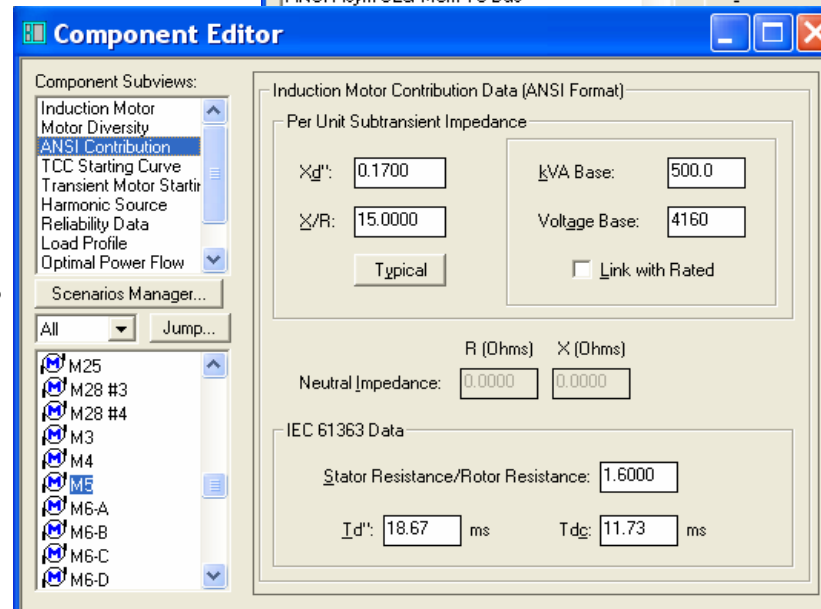
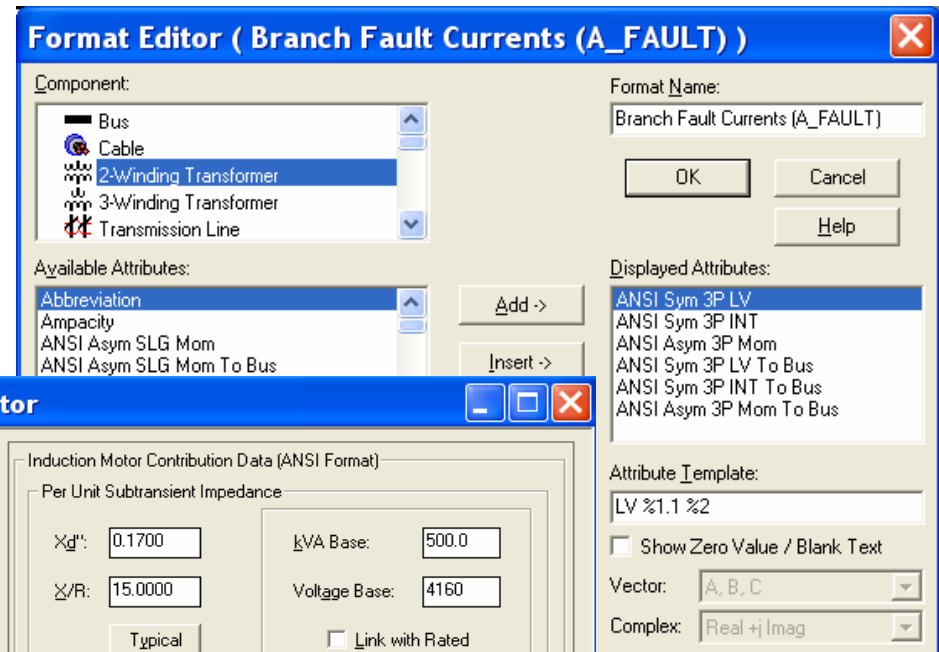
- Provides for the sharing of data between **SKM PowerTools for Windows** (PTW) electrical engineering software and the **ShipConstructor** software database.
- Includes the definition of all electrical power distribution components and cabling.



# SKM PowerTools for Windows (PTW)

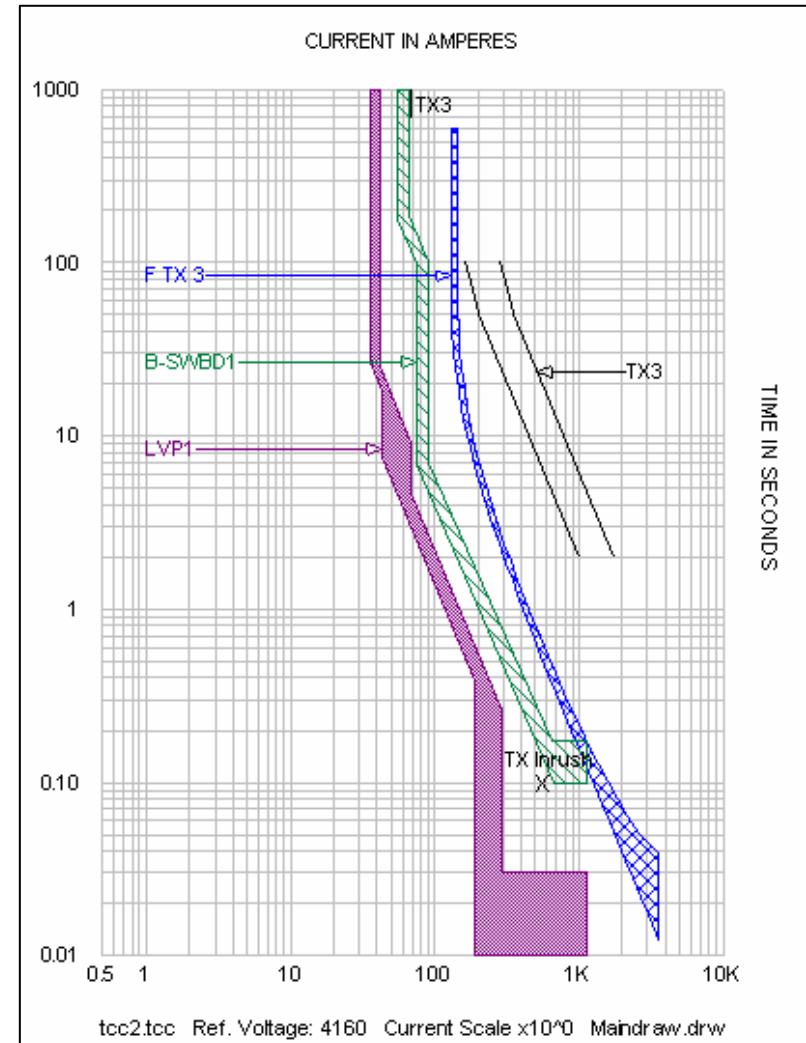
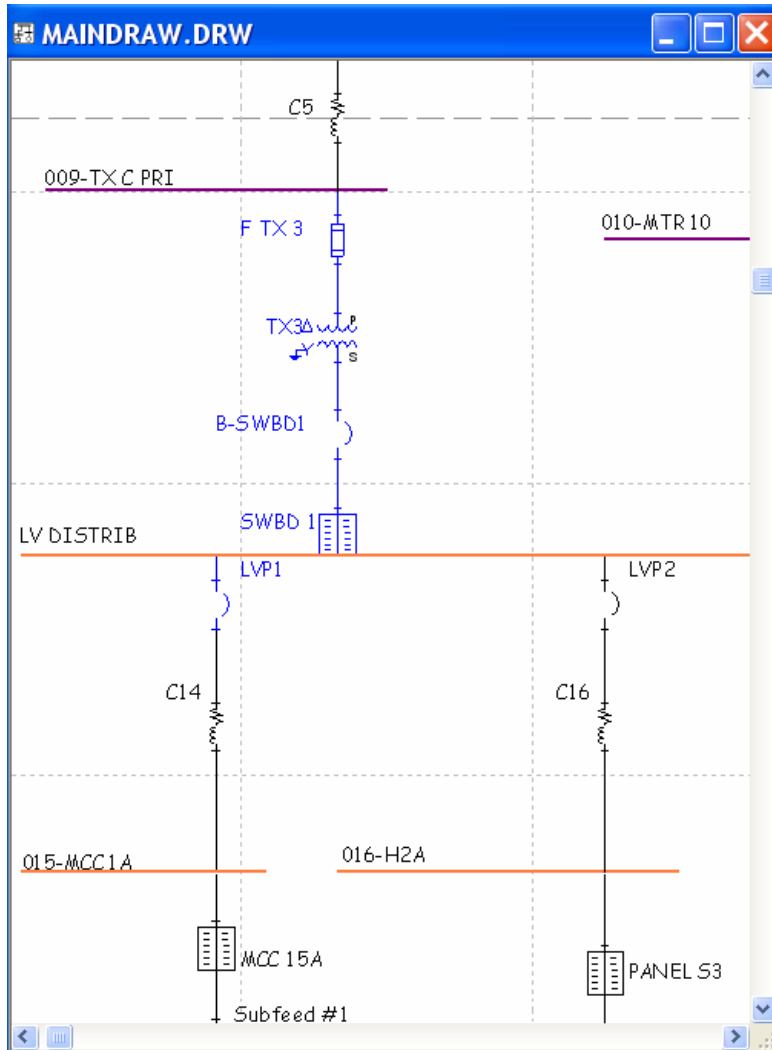
Extensive electrical systems modeling/analysis capability

- Cable and equipment libraries
- One-line diagrams
- Fault current studies
- Coordination studies
- Voltage drop calculations
- Device evaluation
- Load flow analysis
- Harmonic analysis
- Motor starting studies
- Transient analysis
- Arc fault studies





# SKM PowerTools for Windows (PTW)





# SKM PTW Major Modifications

- Definition of power **assemblies** (switchboards, panels, and other power distribution equipment) by assignment of discrete components: buses, breakers, switches, fuses, motor circuit protectors, etc.
- Assignment of **physical parameters** to each assembly that will allow for complete specification of the assembly:
  - Enclosure rating
  - Mounting
  - Door type
  - Sub-feeds
  - Neutral ratings
  - Breaker options
- Creation of **industrial/marine cable library**



# ShipConstructor Electrical Module

- Development of a **cable management system** that will allow parametric design of cable routing that is **fully integrated** with structures, equipment, piping, HVAC and other outfitting.
- Allows complete definition of all **cables, cable support structures, cable routing, and equipment termination** requirements.



# Catalogs & Libraries

- Cable library
- Cable supports library
- Equipment library

Cable Support Library

| Export                   | Cable Support Type | In Use                   | Stock Name              | Is Periodic                         | Description   | Weight | Insertion Perio |
|--------------------------|--------------------|--------------------------|-------------------------|-------------------------------------|---|--------|-----------------|
| <input type="checkbox"/> | Tray               | <input type="checkbox"/> | 6" Basket Tray (Draigh) | <input checked="" type="checkbox"/> | 6" x 24"  | 0.95   | 20              |
| <input type="checkbox"/> | Tray               | <input type="checkbox"/> | 6" RTND / PHBL          | <input checked="" type="checkbox"/> | RTND Intermediate Wireway - Plate Hanger Bottom Loading 3" wide | 2.1    | 24              |
| <input type="checkbox"/> | Tree               | <input type="checkbox"/> | 3 Tier 6" RTND / CT     | <input checked="" type="checkbox"/> | RTND Major Wireway - Navy Standard Crossier                     | 2.3    | 24              |
| <input type="checkbox"/> | Tray               | <input type="checkbox"/> | 6" Basket Tray (Elbow)  | <input type="checkbox"/>            | 6" Right Curve Elbow  | 1.1    | 0               |
| <input type="checkbox"/> | Tree               | <input type="checkbox"/> | 2" RTND / PHBL          | <input checked="" type="checkbox"/> | RTND Intermediate Wireway - Plate Hanger Bottom Loading 2" wide | 1.4    | 24              |

Cable Library

Multi-Conductor | Fiber | Composite

| Export                              | Name   | Description   | Overall Armor | Overall Shield | Bend Radius Factor | Outer Diameter | Voltage | Plenum | Ampacity                            | Resistance | Inductive Reactance | Weight |    |
|-------------------------------------|--------|---|---------------|----------------|--------------------|----------------|---------|--------|-------------------------------------|------------|---------------------|--------|----|
| <input type="checkbox"/>            | BC18-2 | Meets UL Standard 1426 and UL Style BC-SW2 for boat cable | PVC           | None           |                    | 6              | 18      | 600    | <input type="checkbox"/>            | 0.5        | 1                   | 1      | 33 |
| <input type="checkbox"/>            | BC16-2 | Meets UL Standard 1426 and UL Style BC-SW2 for boat cable | PVC           | None           |                    | 6              | 16      | 600    | <input type="checkbox"/>            | 0.7        | 1                   | 1      | 42 |
| <input checked="" type="checkbox"/> | BC16-3 | Meets UL Standard 1426 and UL Style BC-SW2 for boat cable | PVC           | None           |                    | 6              | 16      | 600    | <input checked="" type="checkbox"/> | 0.7        | 1                   | 1      | 59 |

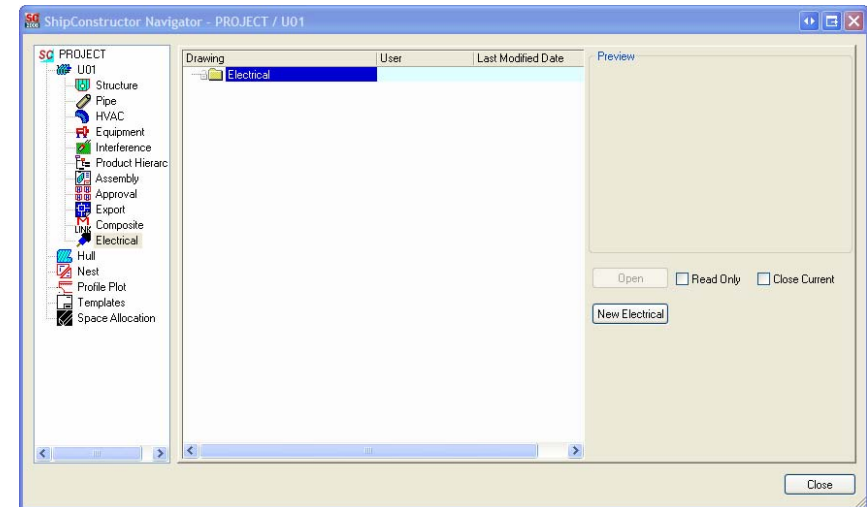
  

| Component Type | Name  | Description     |
|----------------|-------|-----------------|
| Conductor      | Black | 26/30 Stranding |
| Shield         | SB    | 0.030"          |
| Conductor      | Green | 26/30 Stranding |
| Shield         | SG    | 0.030"          |
| Conductor      | White | 26/30 Stranding |
| Shield         | SW    | 0.030"          |



## Drawing types

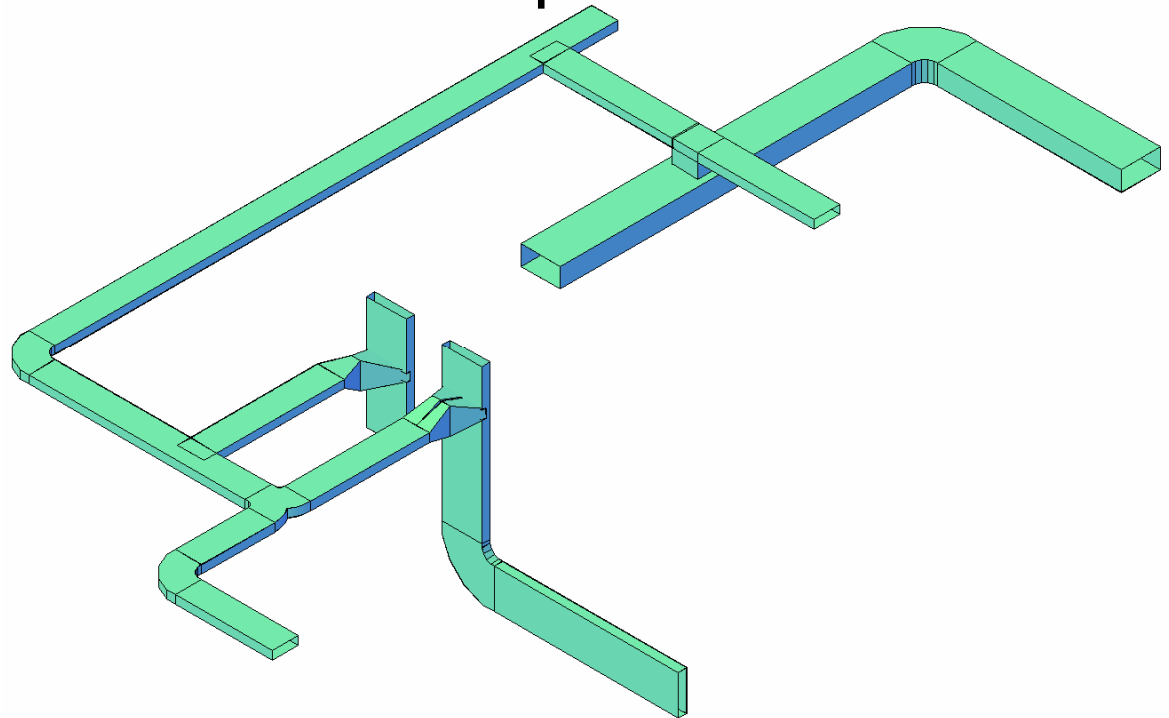
- Space Allocation
  - Non unit bound, use for space allocations
- Electrical Model Drawing
  - Unit bound, used for cable supports
- Cable routing Workspace
  - SandBox for routing cables





## Space Allocation

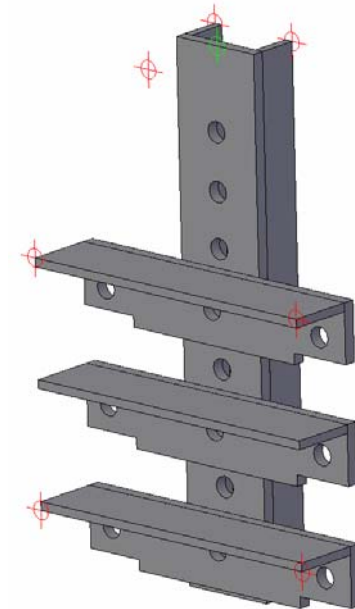
- Use powerful routing tools to quickly allocate the required space for wireways
- Fully connected system that can be modified with all the tools available in ShipConstructor





# Cable Supports

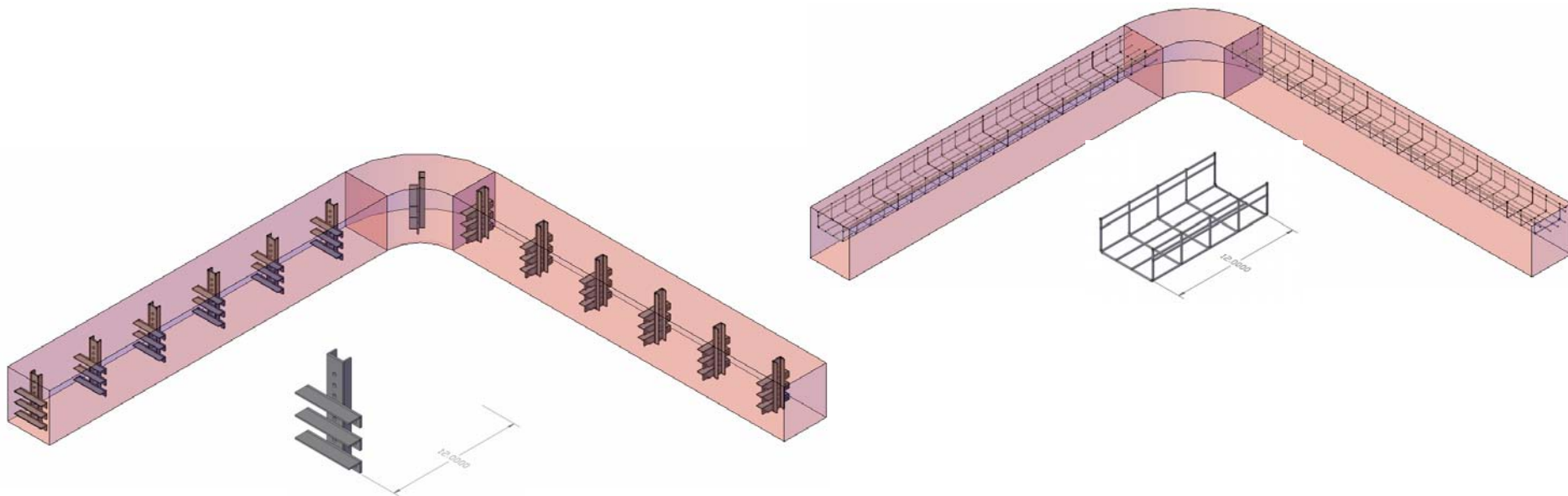
- Support for arbitrary geometry
- Repeating & non-repeating cable supports
- User defined insertion points specified when creating the cable support model





## Routing cable supports

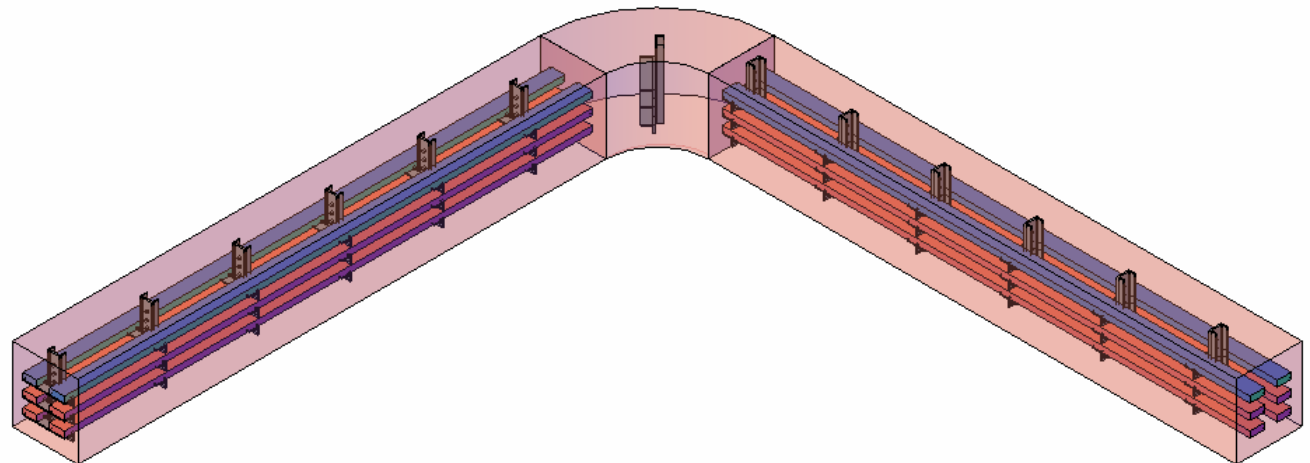
- Assign user defined cable support geometry with allocated space.
- ShipConstructor only differentiates between repeating and non-repeating





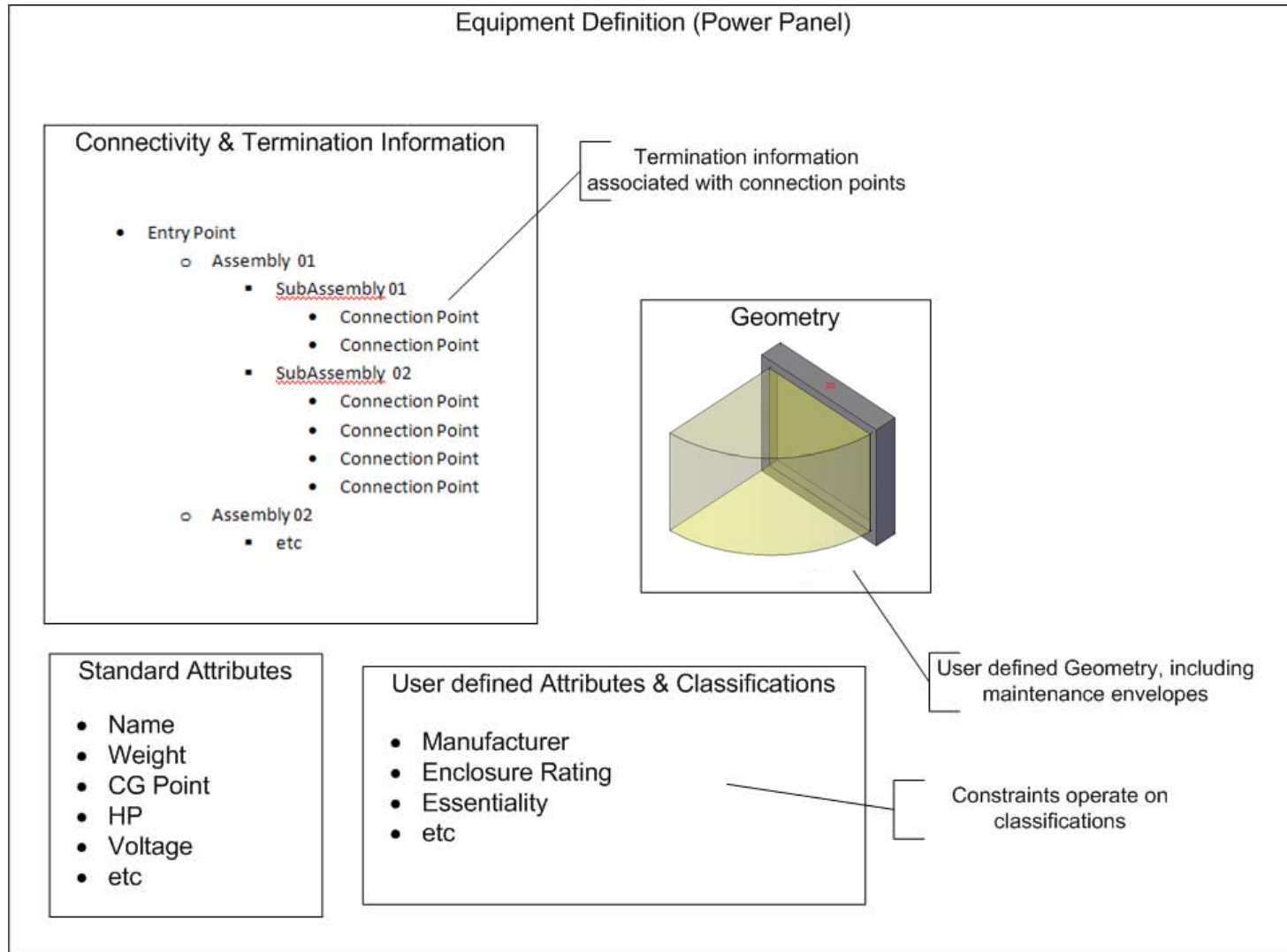
## Defining cable spaces

- Add cable spaces to indicate where cables can run
  - Used for fill ratios
  - Associated with EMC (Electro-magnetic compatibility) Zones
  - Associated with stacking rules (spaced, trefoil, bunched etc)
  - Only straight sections have cable spaces





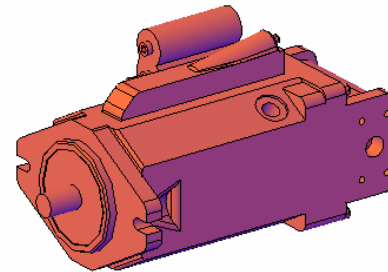
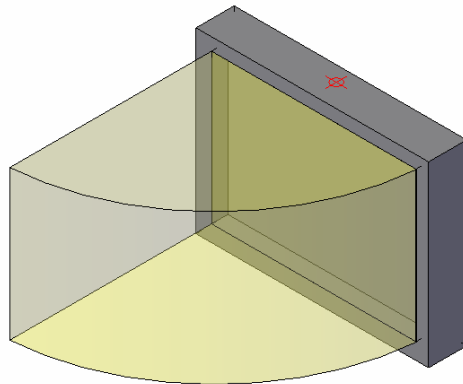
# Equipment definitions





# Locating equipment

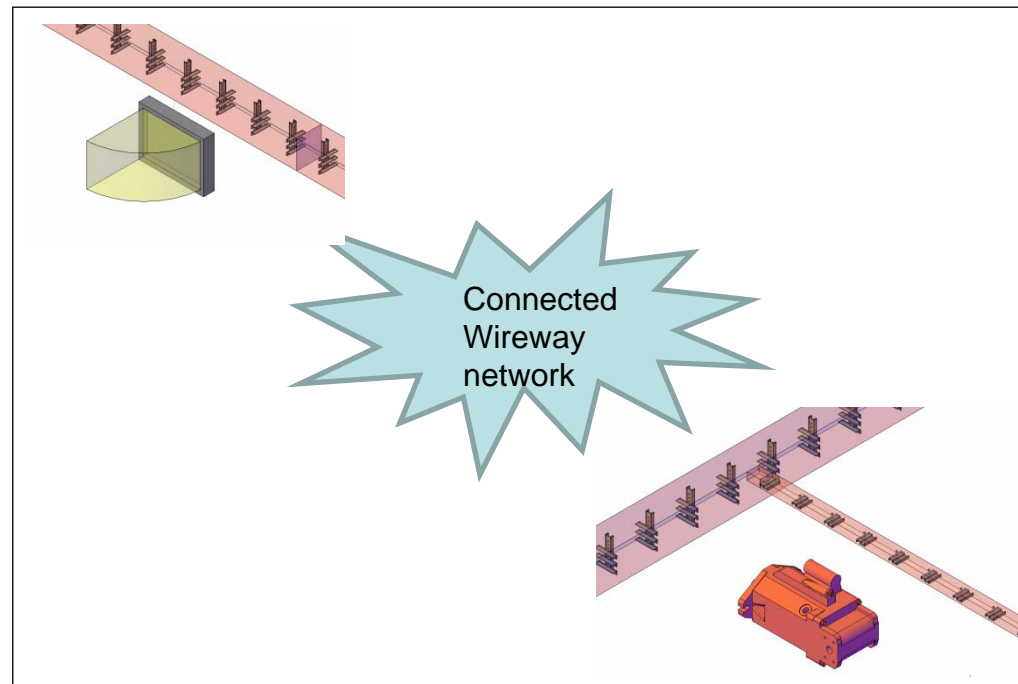
- Existing ShipConstructor equipment module with specific enhancements for electrical
- Equipment is classified upon insertion
- Constraints are applied based on compartment and classification rules (more on this later)





# Cable routing

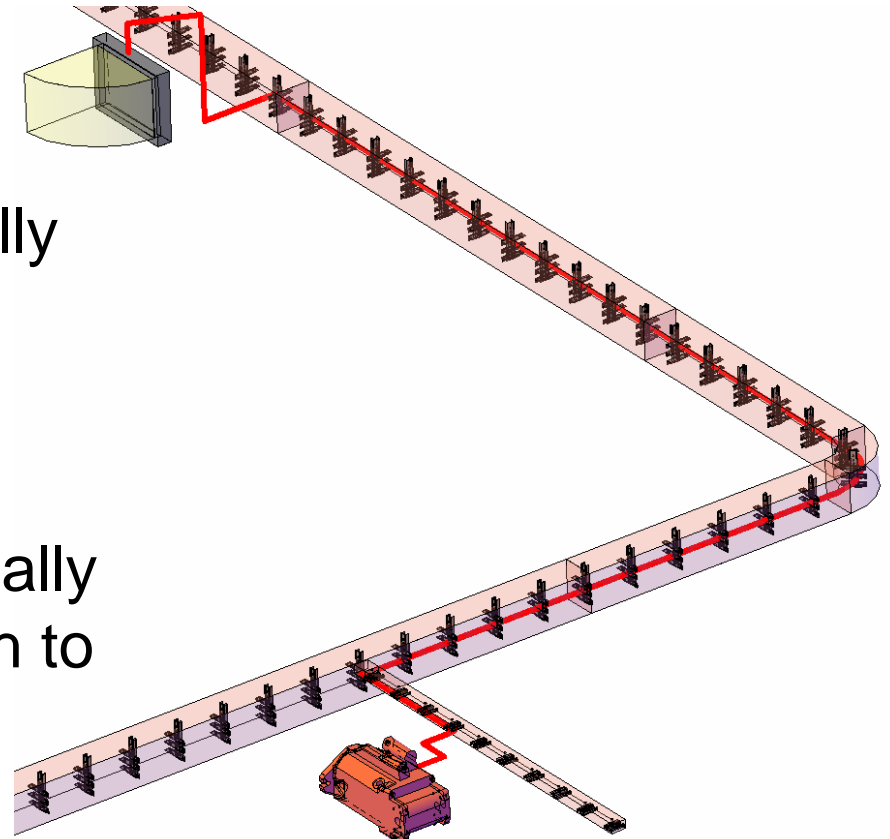
- Select starting and ending pieces of equipment
- Select entry and exit points in wireway network





## Cable routing con't

- Choose cable type, classification, and valid EMC Zones
- ShipConstructor automatically calculates all possible path (sorted by path length)
- User has the ability to manually choose nodes through which to route the cable





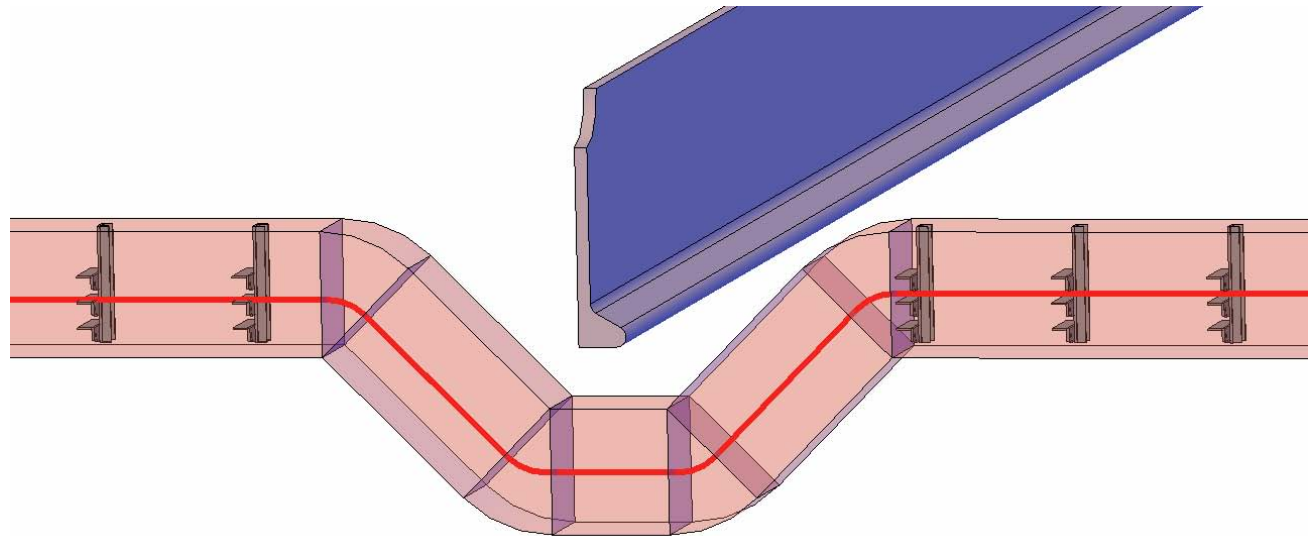
# Cable routing con't

- Warnings
  - Bend radius violated
  - Cable space is too full
  - Classification violations
- User is always able to insert the cable, but is warned that the model may be invalid.



## Cable routing con't

- Cables follow path of space allocations
- Allows to define complex, unsupported path around obstacles



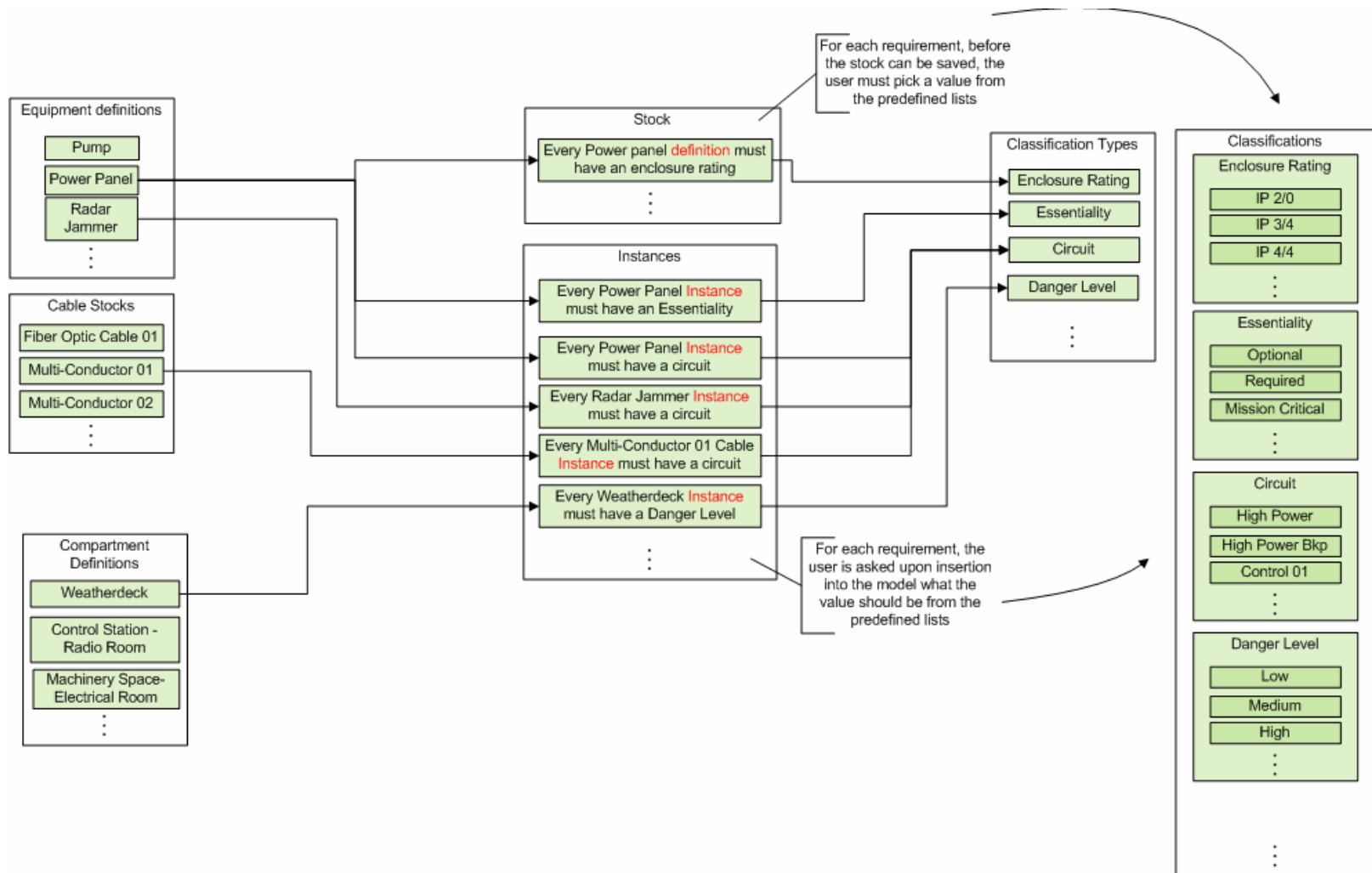


# Classifications & Constraints

- User defined rules specify what is valid in the context of the current project
- Rule databases can be imported / exported for future re-use
- ShipConstructor can warn the user if the rules are violated, or enforce them as items are being placed

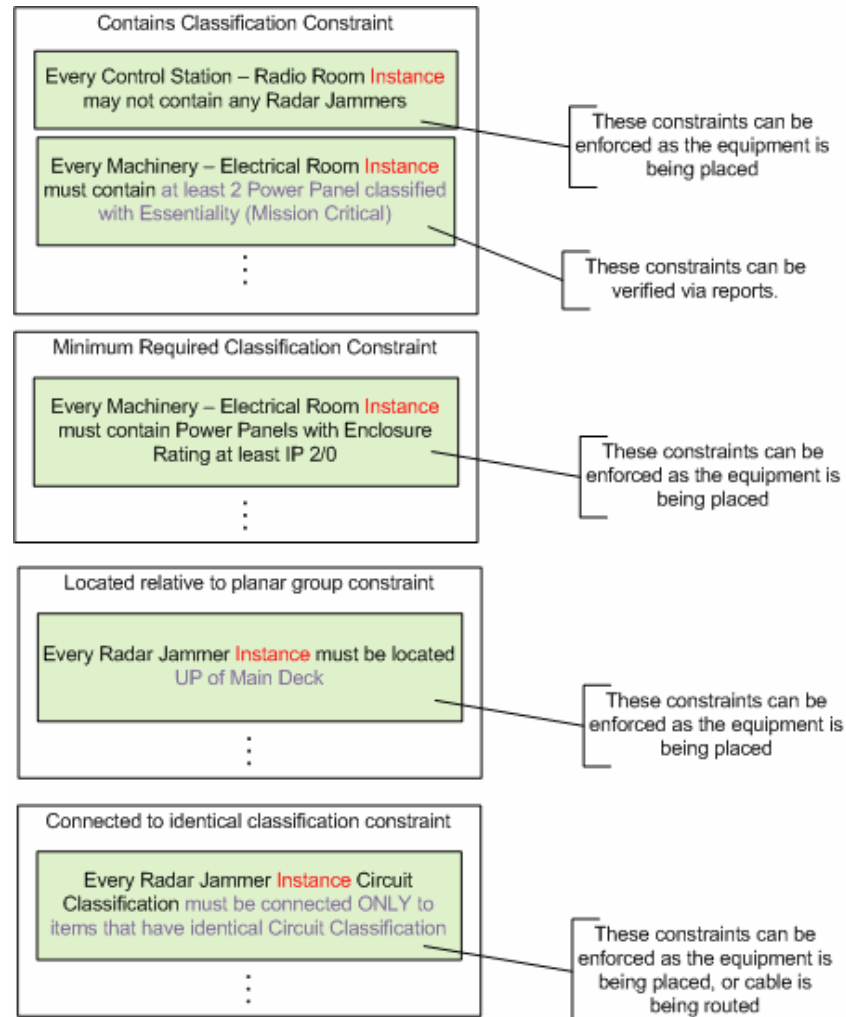


# Classification & Constraints con't





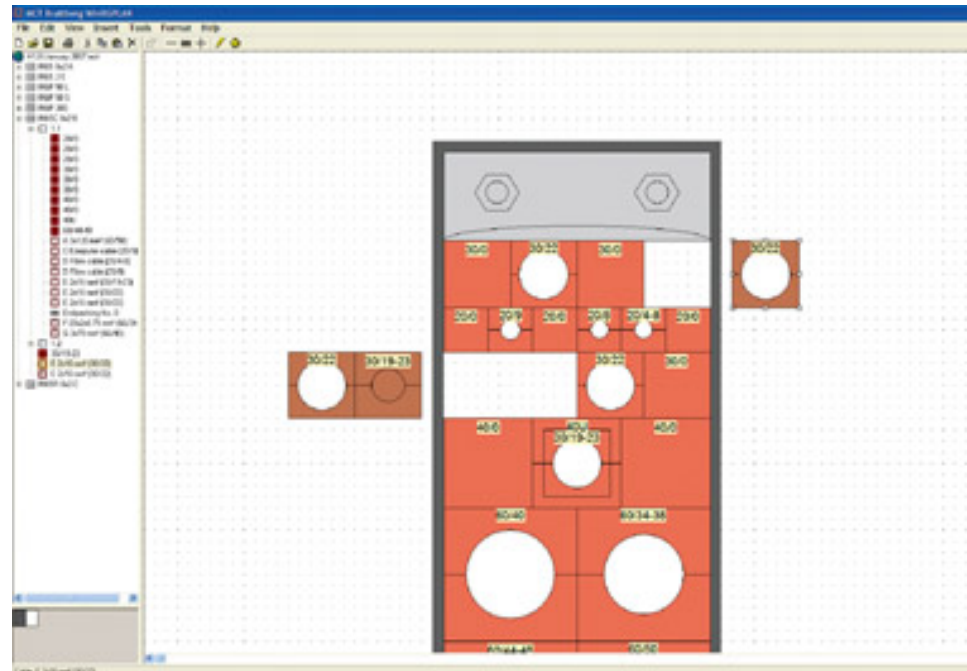
# Classifications & Constraints con't





# Transits & Penetrations

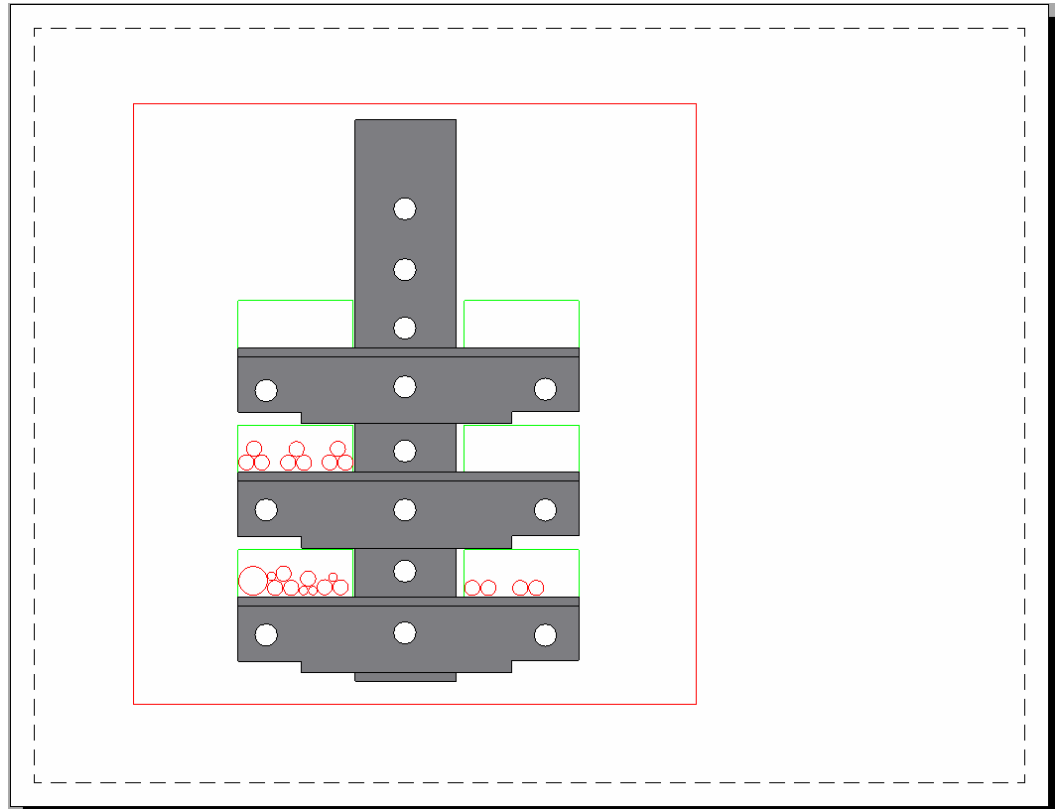
- Support for Penetrations, Transits, Stuffing tubes
- Potential to integrate with MCT Brattberg WinRG (Insert block nesting software)





# Support cross section drawing

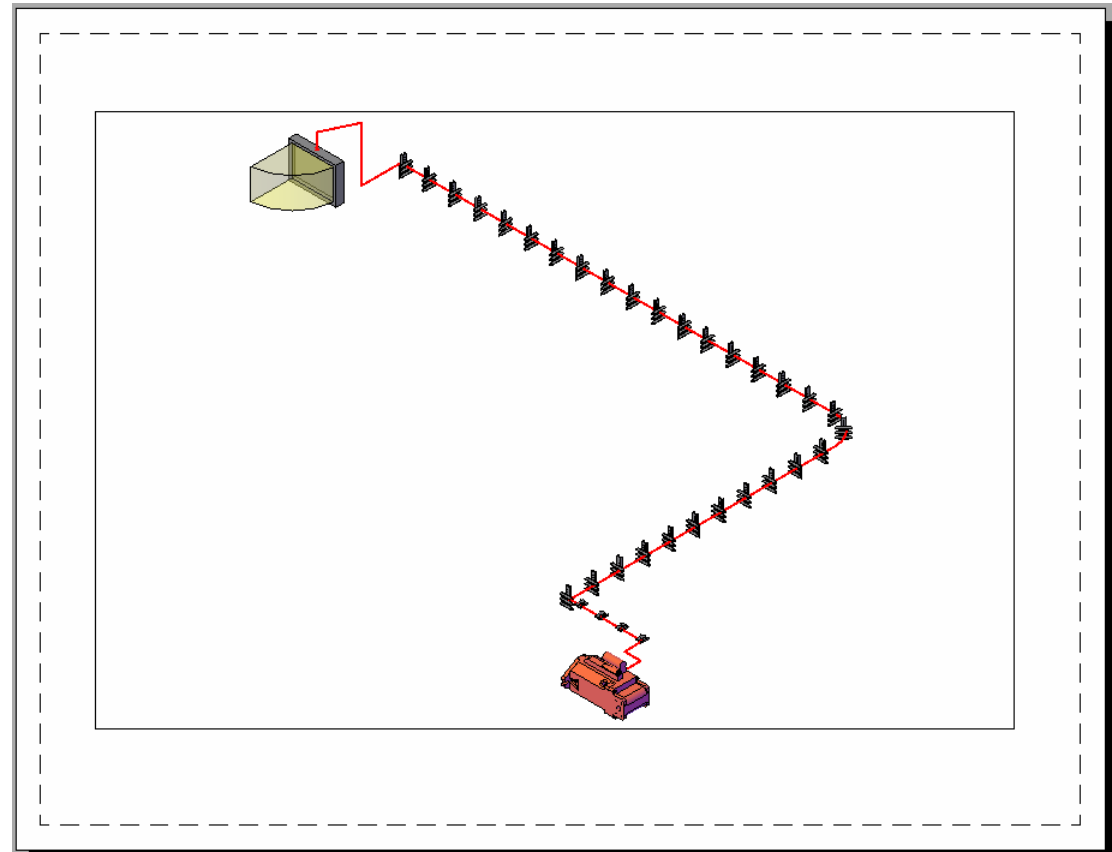
- Users can generate cross section drawings at any node in the system
- Shows current fill status of each cable space





# Cable pull drawings & pull sheets

- Generate ISO drawings that show the actual cable route
- Also produce a pull sheet report to go with the ISO that lists what the drawing shows graphically





# Hookup sheets

- From termination information and cable routing information
  - Produce tag numbers for each cable
  - Produce hook-up sheets indicating the termination type, accessories required etc.



# Integrate with existing concepts

- Full support to show electrical objects in
  - Arrangements
  - Assemblies
  - Export, WorkShop, etc drawings



# Reports

- Reports module is extended to support all aspects of electrical



# THE END

## Questions?