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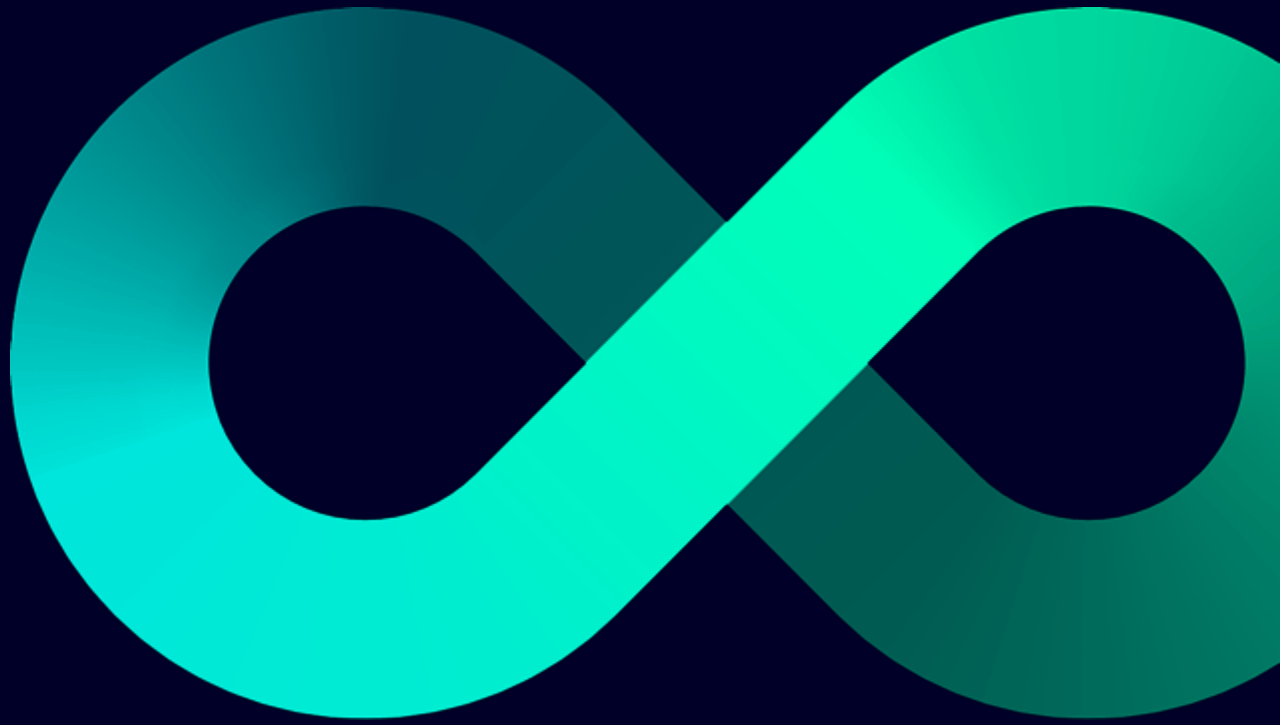
APPLIED CAx

NX Mechanical Routed System Designer Configuration and Administration



Scott Painter, **Applied CAx**
Design & Manufacturing Application Engineer

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SCOTT PAINTER

APPLIED CAx

Design & Manufacturing Application Engineer

BACKGROUND

Scott Painter has over 28 years of industry experience spanning multiple industries. He focused on product design in the beginning of his career with Callaway Golf, Ford, Motorola, and ATK Aerospace. For the past 10 years, he has focused on Application Support and Configuration while working on projects for SpaceX, Boeing, Navistar and Moog Aerospace before joining the Applied CAx team.

EDUCATION

- Bachelor's degree in Physics from Western Illinois University
- Veteran - U.S. Army/U.S. Army Reserve Non-Commissioned Officer

EXPERTISE

Tools: NX, Teamcenter, Active Workspace

Technical: NX Installation, Configuration and Implementation, NX Reuse Library Development and Administration, NX Routing and Routed System Designer Configuration and Administration, NX Diagramming Library, NX Part Families, Advanced Surfacing & Work-around solution expert.

Functional: Customer Support, Training Development and Mentoring, Expert user level understanding of NX and CAD.

EXPERIENCE

Product Design 1996-2013: Automotive, Aerospace, Consumer Appliances and Electronics, and Sporting Goods

Application Engineering and Support 2014- Present: SpaceX, Boeing, Navistar, Moog Aerospace, and Applied CAx.

Scott's background in product design and as an end user of CAD systems allows him to provide exceptional and personalized customer support. His real-world experience lends itself to being able to relate not only to a customer's needs, but the urgency in which they require a solution.

His unique blend of experiences from multiple industries has allowed him to become familiar with a wide range of the NX toolset. He enjoys digging into the "how and why" does the tool work more than most.

He has provided NX Routing and Routing System Designer installation assistance and library configuration.

Scott is one of the first to successfully configure and install NX Diagramming Libraries in a AWC managed environment.

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What is Applied CAx?

FINITE ELEMENT ANALYSIS
Predictive Engineering

APPLIED CAx

A Siemens Software Partner built from a joint venture of Predictive Engineering (FEA consulting services) and Applied CAx, a systems integrator.

Focused on A&D and Renewable Energy, Applied was recognized as Siemens North American Partner of the Year: 2023, 2020, and 2016.

NX CAE FEMAP LS-DYNA STAR-CCM+ NX TEAMCENTER FIBERSIM PLANT SIM PROCESS SIM

- 5 simulation engineers (PhDs, MEs, PEs)
- FEA consultants
- CFD consultants
- Training for FEMAP & NX Nastran
- Training for LS-DYNA Implicit & Explicit

- 9 veteran Teamcenter architects
- 4 Senior NX Application Engineers
- Training for NX CAD/CAM & Teamcenter
- Deep design experience
- PDM experience

Aerospace and Defense Clients we have helped

APPLIED CAx

AeroTEC
TESTING | ENGINEERING | CERTIFICATION

Teamcenter PLM Implementation, NX CAD – CAM, CFD and CAE support

SNC SIERRA NEVADA CORPORATION

CAE support & training, process standardization & workflow development

ROCKETLAB

Teamcenter PLM Implementation, NX CAD – CAM, CFD and CAE support

Nammo

Teamcenter PLM Implementation, Solid Edge integration, training & workflows

VENUS AEROSPACE

Teamcenter PLM Implementation, NX CAD – CAM, CFD and CAE support

STRATOLAUNCH

Teamcenter PLM Implementation, NX CAD – CAM, CFD and CAE support

JANICKI

Manufacturing process improvements, NX CAM Training, CAE training & support

Joby

CFD and CAE training and support

Relativity

Teamcenter, NX CAD – CAM, CFD and CAE support

SIERRA SPACE

Teamcenter, NX CAD – CAM, CFD and CAE support

Systima Technologies, INC.

CAE training, mentorship & support

EXOTIC METALS FORMING

Parker

Teamcenter PLM Implementation, driving best practices for design in NX CAD & NX CAM manufacturing

Teamcenter Customer:

APPLIED CAx

Agenda

Overview

Basics of Routing Configuration Files

Configuration File Deep Dive

Best Practices

Demo

Q&A

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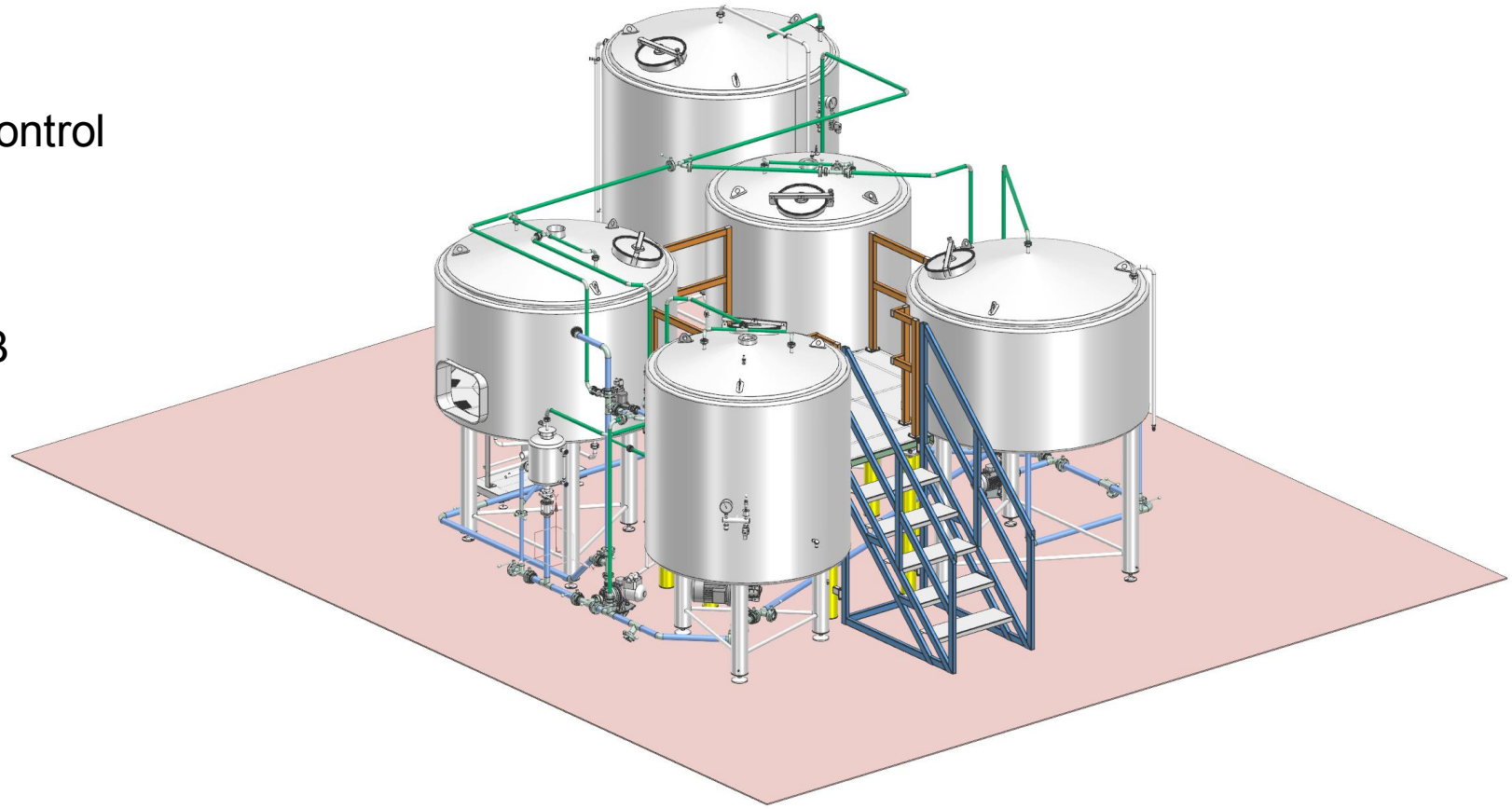
What is Routed System Designer (RSD)?

Routing System Designer is the “next-generation” of routing applications for Siemens NX that works with existing NX Routing Libraries

- Improved Functionalities
  - All new creation and editing tools
  - New stock part management and control
  - New Run Management
- Fully released with NX 2007
  - Mechanical RSD is available OOTB
  - Electrical RSD is available via Early Access Feature



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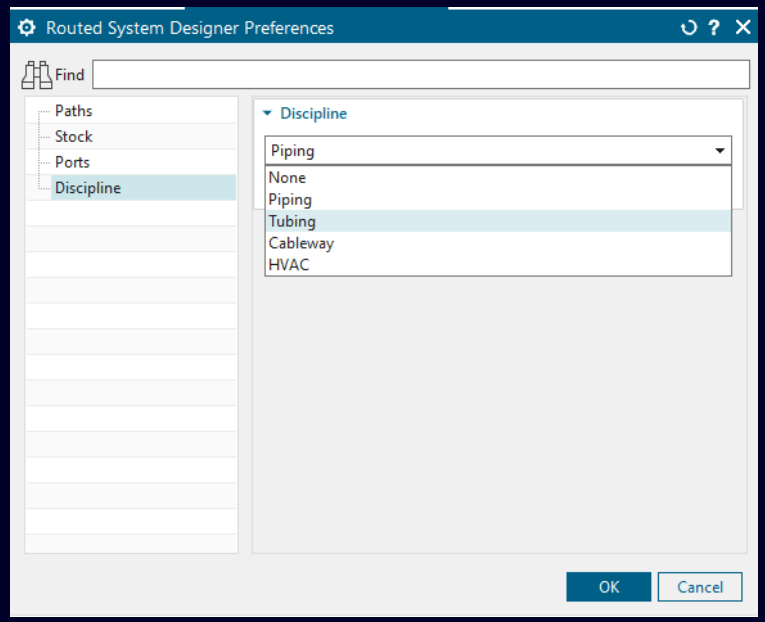
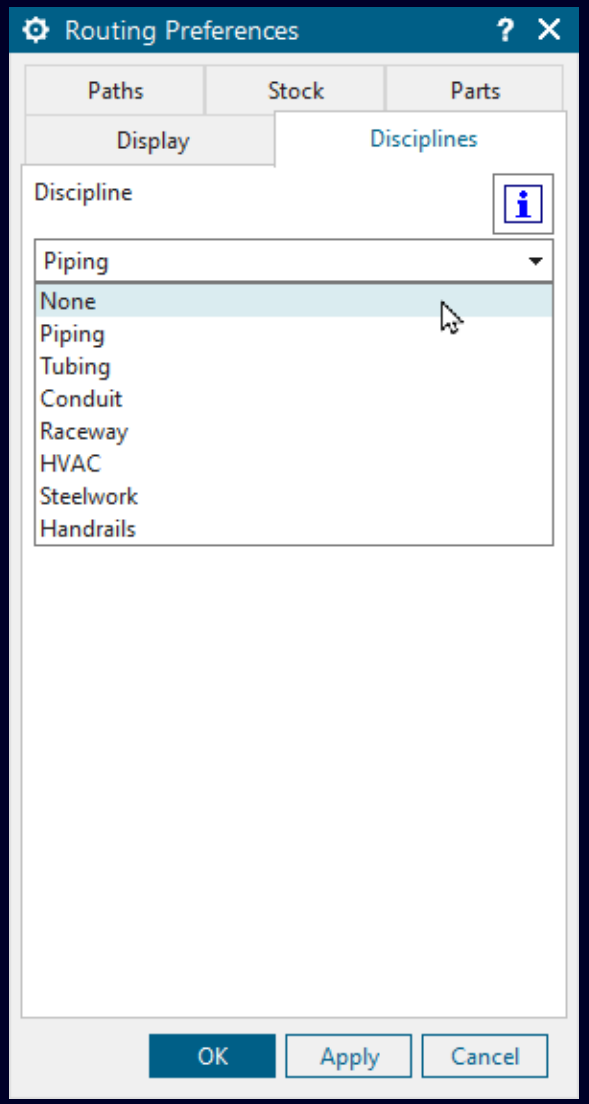
The Routing Part Library Interface





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Types of Routing Configuration Files

.apv file

APPLICATION VIEW FILE
- Configures Disciplines
- Points to appropriate .plv file

.plv file

PART LIBRARY VIEW FILE
- Specifies nodes and sub nodes in routing library
- Points to appropriate .ptb files for each node/sub node

.ptb file

PART TABLE FILE
- Specifies family members available
- Configures attributes

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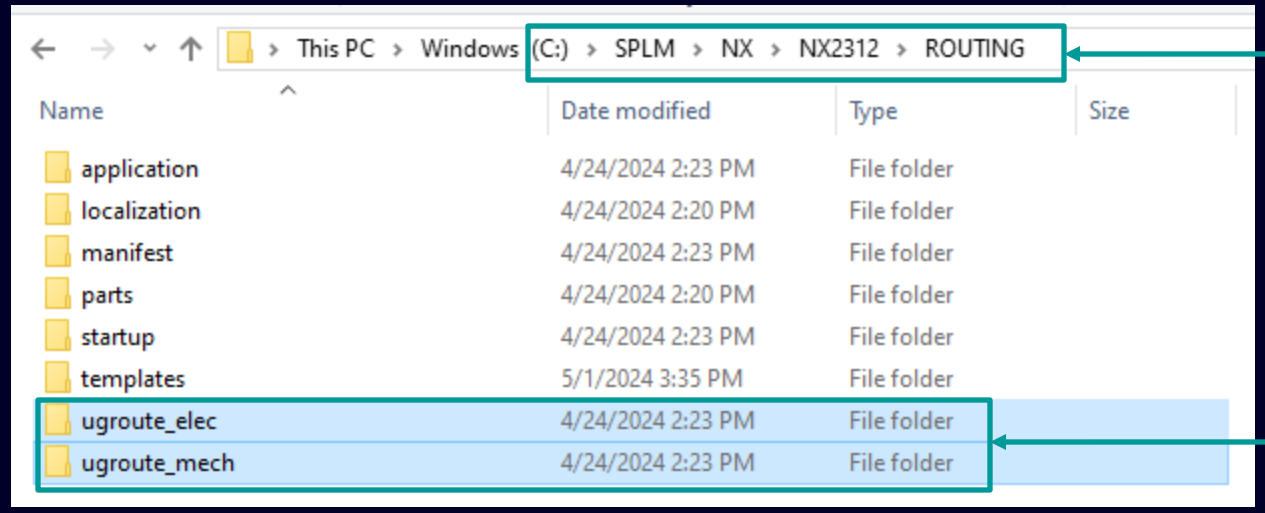
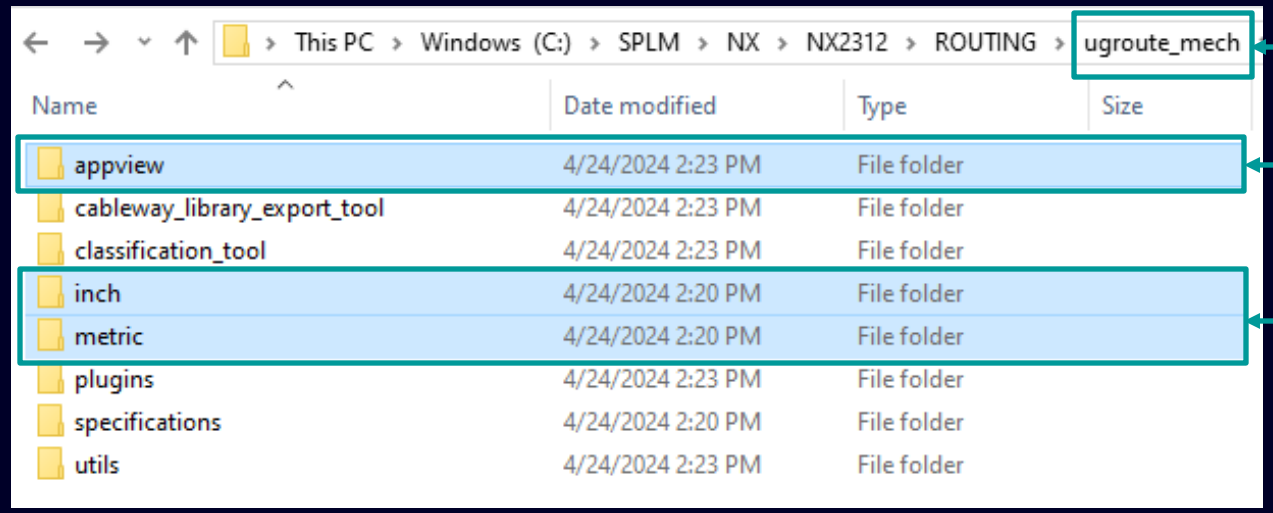
Where do these files live OOTB?



NX Install Directory

Electrical and Mechanical Folders



ugroute_mech

APV and PLV Files

PTB Files are located in the appropriate unit folder in the sub folder named Tables

This folder structure needs in a network location. If using NX Custom see README Routing.txt file in Nxcustom\NX<Version>library\Routing folder for instructions. If not using NX Custom the file locations are set in ugii_env_ug.dat.

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APV File Contents

NX Routing APV's

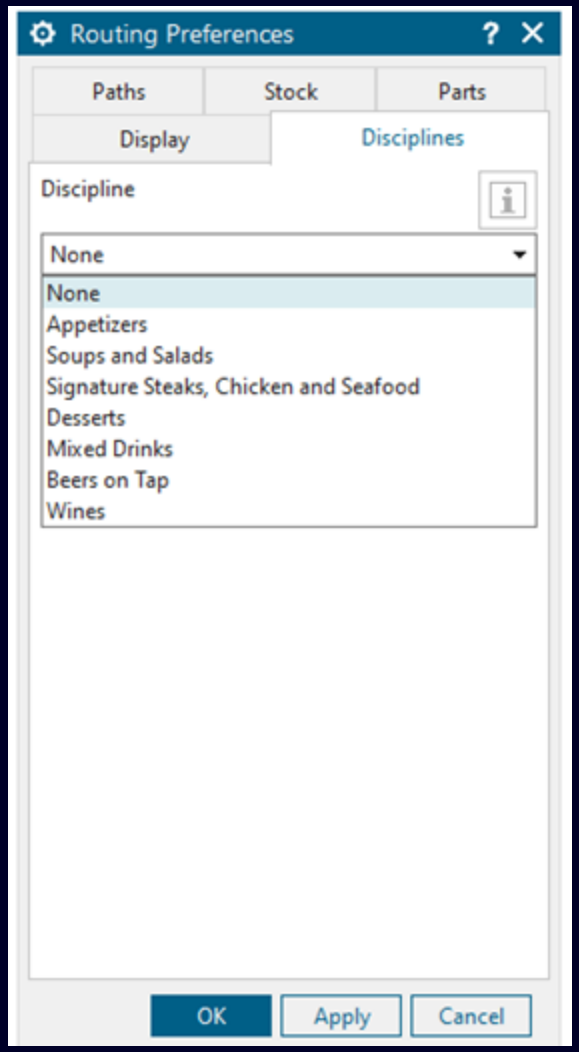
ugroute_mech_inch.xml
ugroute_mech_metric.xml
ugroute_elec_inch.xml
ugroute_elec_metric.xml

NX RSD APV's

ugroute_rsd_mech_inch.xml
ugroute_rsd_mech_metric.xml
ugroute_rsd_elec_inch.xml
ugroute_rsd_elec_metric.xml

Application view files contain the following:

1. Name
2. Description
3. Part Preferences – preferences directly related to part operations. The <Part Library> preference is where the appropriate .PLV file is called out.
4. User Preferences – user preference values that are used by Design Rule checkers and Open C API programs
5. Callbacks – callback elements specify a shared library and entry point to execute during certain routing operations. None are specified OOTB
6. Plugins – plugin elements specify a shared library and entry point to execute in place of certain routing functionality
7. Design Rules – design rule elements specify design rules to automatically apply after various routing operations
8. Disciplines – discipline elements specify the name, start fitting node, start stock node, and other discipline characteristics



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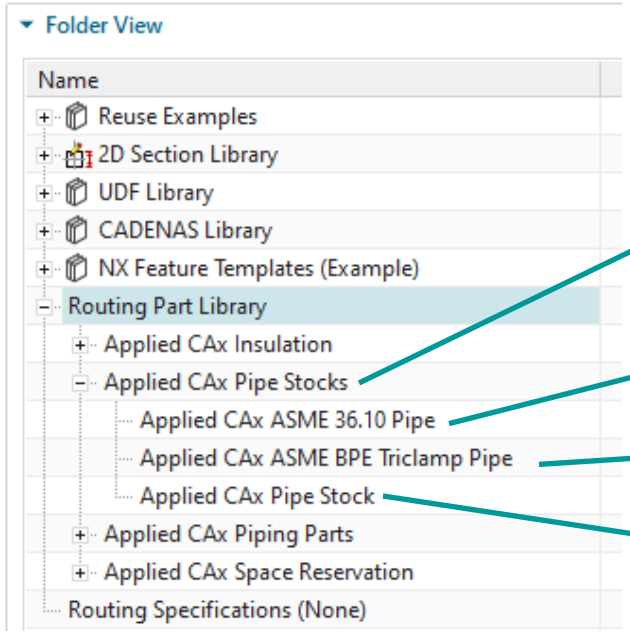
PLV File Example

NX Routing APV's

ugroute_mech_inch.plv
ugroute_mech_metric.plv
ugroute_elec_inch.plv
ugroute_elec_metric.plv

NX RSD APV's

ugroute_rsd_mech_inch.plv
ugroute_rsd_mech_metric.plv
ugroute_rsd_elec_inch.plv
ugroute_rsd_elec_metric.plv




```
NODE BASE
    NAME Base
    SUBNODES   PARTS  STOCK  PIPING_CONNECTIONS
END_OF_NODE

NODE STOCK
    NAME  All Stock
    SUBNODES  PIPING STOCK
    SUBNODES  TUBING_STOCK  CONDUIT_STOCK
    SUBNODES  RACEWAY_STOCK  STEELWORK_STOCK
    SUBNODES  SPACE_RESERVATION
    SUBNODES  INSULATION
END_OF_NODE

NODE PIPING_STOCK
    NAME  Applied CAx Pipe Stocks
    SUBNODES  PIPE STOCK
    SUBNODES  PIPE_STOCK_ASME_36.10
    SUBNODES  PIPE_STOCK_ASME_BPE
END_OF_NODE

NODE  PIPE_STOCK_ASME_36.10
   NAME Applied CAx ASME 36.10 Pipe
   TABLE Steel_Pipe_ASME_36.10.ptb
END_OF_NODE

NODE  PIPE_STOCK_ASME_BPE
   NAME Applied CAx ASME BPE Triclamp Pipe
   TABLE Steel_Pipe_ASME_BPE.ptb
END_OF_NODE

NODE  PIPE_STOCK
   NAME Applied CAx Pipe Stock
   TABLE piping_stock.ptb
END_OF_NODE
```

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PTB Files

- Part table files set up the information for the parts and stock that are generated by the Routing Library
- The COLUMNS section of a PTB file sets up the columns that are in the DATA section of the PTB file and the searchable fields in the Routing Reuse Search dialog box.
- The DATA section of a PTB file aligns with the Part Family Template/Members attributes
- The APPLIED sections of a PTB file set variables that are used in the creation of Attributes

```
COLUMNS
        STRING/HIDE         MEMBER_NAME
        REAL                NPS
        REAL/HIDE           OD1
        REAL/HIDE           WT
        REAL/HIDE           t1
        STRING              SCH
        STRING/HIDE         MATERIAL
        STRING/HIDE         MATERIAL_CODE
        STRING/HIDE         PIPE_STANDARD
        STRING/HIDE         PART_NUMBER
        STRING/HIDE         PART_NAME
END_OF_COLUMNS
```

```
DATA
!MEMBER_NAME              NPS OD1 WT   t1   SCH MATERIAL    MATERIAL_CODE   PIPE_STANDARD   PART_NUMBER          PART_NAME
"Steel_Pipe_DN1-2_10SCH"    0.5 0.84    0.997   0.08    "10"    "AISI_310_SS"   "Grd P5"        "ASME B36.10"   "Steel_Pipe_DN1-2_10SCH"    "Steel_Pipe_ASME_36.10"
"Steel_Pipe_DN3-4_10SCH"    0.75    1.05    1.28    0.08    "10"    "AISI_310_SS"   "Grd P5"        "ASME B36.10"   "Steel_Pipe_DN3-4_10SCH"    "Steel_Pipe_ASME_36.10"
"Steel_Pipe_DN1_10SCH"      1   1.31    2.098   0.11    "10"    "AISI_310_SS"   "Grd P5"        "ASME B36.10"   "Steel_Pipe_DN1_10SCH"      "Steel_Pipe_ASME_36.10"
"Steel_Pipe_DN1_1-4_10SCH"  1.25    1.66    2.694   0.11    "10"    "AISI_310_SS"   "Grd P5"        "ASME B36.10"   "Steel_Pipe_DN1_1-4_10SCH"  "Steel_Pipe_ASME_36.10"
"Steel_Pipe_DN1_1-2_10SCH"  1.5 1.9 3.11    0.11    "10"    "AISI_310_SS"   "Grd P5"        "ASME B36.10"   "Steel_Pipe_DN1_1-2_10SCH"  "Steel_Pipe_ASME_36.10"
"Steel_Pipe_DN2_10SCH"      2   2.37    3.929   0.11    "10"    "AISI_310_SS"   "Grd P5"        "ASME B36.10"   "Steel_Pipe_DN2_10SCH"      "Steel_Pipe_ASME_36.10"
"Steel_Pipe_DN2-1-2_10SCH"  2.5 2.87    5.253   0.11    "10"    "AISI_310_SS"   "Grd P5"        "ASME B36.10"   "Steel_Pipe_DN2-1-2_10SCH"  "Steel_Pipe_ASME_36.10"
"Steel_Pipe_DN3_10SCH"      3   3.5 6.459   0.12    "10"    "AISI_310_SS"   "Grd P5"        "ASME B36.10"   "Steel_Pipe_DN3_10SCH"      "Steel_Pipe_ASME_36.10"
"Steel_Pipe_DN4_10SCH"      4   4.5 8.363   0.12    "10"    "AISI_310_SS"   "Grd P5"        "ASME B36.10"   "Steel_Pipe_DN4_10SCH"      "Steel_Pipe_ASME_36.10"
"Steel_Pipe_DN5_10SCH"      5   5.56    11.578  0.12    "10"    "AISI_310_SS"   "Grd P5"        "ASME B36.10"   "Steel_Pipe_DN5_10SCH"      "Steel_Pipe_ASME_36.10"
"Steel_Pipe_DN6_10SCH"      6   6.63    13.84   0.13    "10"    "AISI_310_SS"   "Grd P5"        "ASME B36.10"   "Steel_Pipe_DN6_10SCH"      "Steel_Pipe_ASME_36.10"
"Steel_Pipe_DN8_10SCH"      8   8.63    19.956  0.15    "10"    "AISI_310_SS"   "Grd P5"        "ASME B36.10"   "Steel_Pipe_DN8_10SCH"      "Steel_Pipe_ASME_36.10"
"Steel_Pipe_DN10_10SCH"     10  10.75   27.784  0.16    "10"    "AISI_310_SS"   "Grd P5"        "ASME B36.10"   "Steel_Pipe_DN10_10SCH"     "Steel_Pipe_ASME_36.10"
"Steel_Pipe_DN12_10SCH"     12  12.75   35.999  0.18    "10"    "AISI_310_SS"   "Grd P5"        "ASME B36.10"   "Steel_Pipe_DN12_10SCH"     "Steel_Pipe_ASME_36.10"
"Steel_Pipe_DN14_10SCH"     14  14  54.69   0.25    "10"    "AISI_310_SS"   "Grd P5"        "ASME B36.10"   "Steel_Pipe_DN14_10SCH"     "Steel_Pipe_ASME_36.10"
"Steel_Pipe_DN16_10SCH"     16  16  62.637  0.25    "10"    "AISI_310_SS"   "Grd P5"        "ASME B36.10"   "Steel_Pipe_DN16_10SCH"     "Steel_Pipe_ASME_36.10"
"Steel_Pipe_DN18_10SCH"     18  17.99   70.598  0.25    "10"    "AISI_310_SS"   "Grd P5"        "ASME B36.10"   "Steel_Pipe_DN18_10SCH"     "Steel_Pipe_ASME_36.10"
"Steel_Pipe_DN20_10SCH"     20  20  78.545  0.25    "10"    "AISI_310_SS"   "Grd P5"        "ASME B36.10"   "Steel_Pipe_DN20_10SCH"     "Steel_Pipe_ASME_36.10"
"Steel_Pipe_DN22_10SCH"     22  22.01   86.507  0.25    "10"    "AISI_310_SS"   "Grd P5"        "ASME B36.10"   "Steel_Pipe_DN22_10SCH"     "Steel_Pipe_ASME_36.10"
"Steel_Pipe_DN24_10SCH"     24  24.02   94.454  0.25    "10"    "AISI_310_SS"   "Grd P5"        "ASME B36.10"   "Steel_Pipe_DN24_10SCH"     "Steel_Pipe_ASME_36.10"
"Steel_Pipe_DN8_STD"        8   8.63    42.532  0.32    "STD"   "AISI_310_SS"   "Grd P5"        "ASME B36.10"   "Steel_Pipe_DN8_STD"        "Steel_Pipe_ASME_36.10"
"Steel_Pipe_DN10_STD"       10  10.75   60.3    0.36    "STD"   "AISI_310_SS"   "Grd P5"        "ASME B36.10"   "Steel_Pipe_DN10_STD"       "Steel_Pipe_ASME_36.10"
"Steel_Pipe_DN12_STD"       12  12.75   73.828  0.38    "STD"   "AISI_310_SS"   "Grd P5"        "ASME B36.10"   "Steel_Pipe_DN12_STD"       "Steel_Pipe_ASME_36.10"
"Steel_Pipe_DN14_STD"       14  14  81.284  0.38    "STD"   "AISI_310_SS"   "Grd P5"        "ASME B36.10"   "Steel_Pipe_DN14_STD"       "Steel_Pipe_ASME_36.10"
"Steel_Pipe_DN16_STD"       16  16  93.219  0.38    "STD"   "AISI_310_SS"   "Grd P5"        "ASME B36.10"   "Steel_Pipe_DN16_STD"       "Steel_Pipe_ASME_36.10"
"Steel_Pipe_DN18_STD"       18  17.99   105.139 0.38    "STD"   "AISI_310_SS"   "Grd P5"        "ASME B36.10"   "Steel_Pipe_DN18_STD"       "Steel_Pipe_ASME_36.10"
"Steel_Pipe_DN20_STD"       20  20  117.074 0.38    "STD"   "AISI_310_SS"   "Grd P5"        "ASME B36.10"   "Steel_Pipe_DN20_STD"       "Steel_Pipe_ASME_36.10"
"Steel_Pipe_DN22_STD"       22  22.01   129.009 0.38    "STD"   "AISI_310_SS"   "Grd P5"        "ASME B36.10"   "Steel_Pipe_DN22_STD"       "Steel_Pipe_ASME_36.10"
"Steel_Pipe_DN24_STD"       24  24.02   140.944 0.38    "STD"   "AISI_310_SS"   "Grd P5"        "ASME B36.10"   "Steel_Pipe_DN24_STD"       "Steel_Pipe_ASME_36.10"
END_OF_DATA
```

PTB File COLUMNS Section

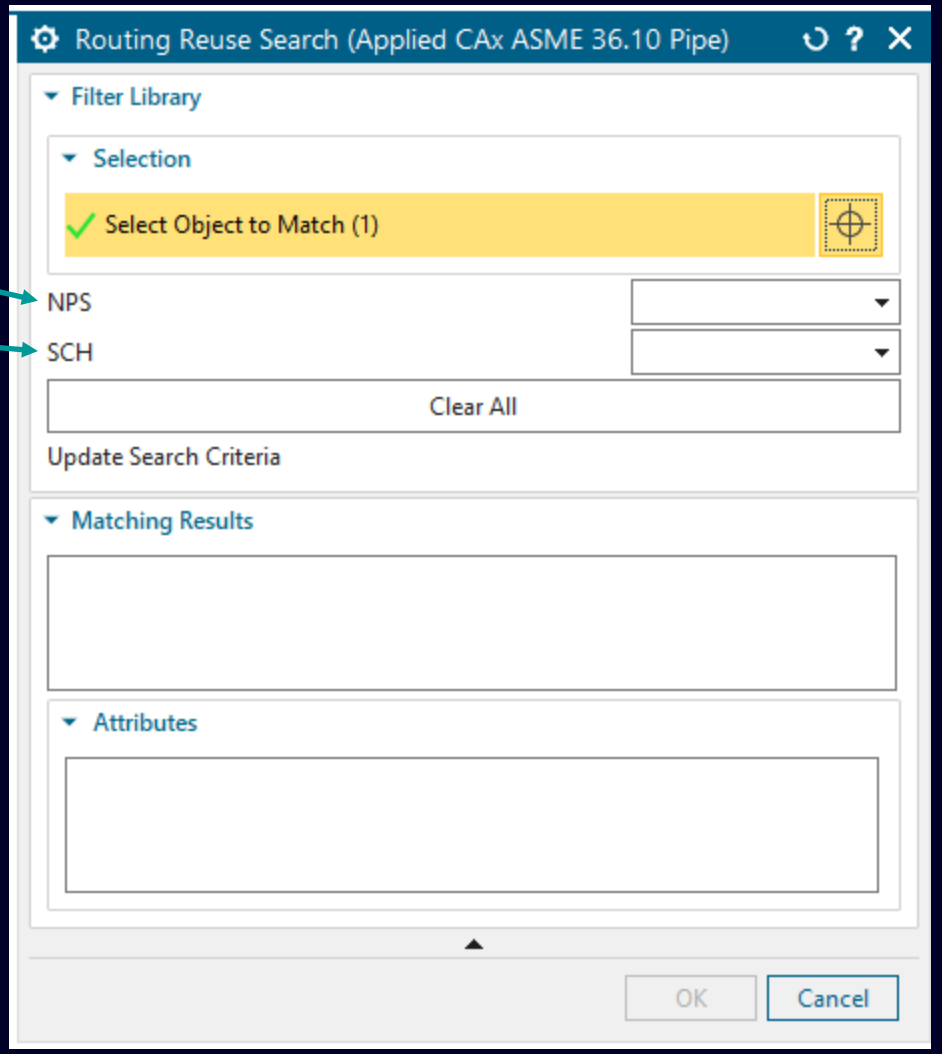
```
COLUMNS
        STRING/HIDE             MEMBER_NAME
        REAL                    NPS
        REAL/HIDE               OD1
        REAL/HIDE               WT
        REAL/HIDE               t1
        STRING                  SCH
        STRING/HIDE             MATERIAL
        STRING/HIDE             MATERIAL_CODE
        STRING/HIDE             PIPE_STANDARD
        STRING/HIDE             PART_NUMBER
        STRING/HIDE             PART_NAME
END_OF_COLUMNS
```

/HIDE is used to prevent columns from appearing in the Routing Reuse Search dialog box

COLUMNS will be assigned to individual line items of part family members as attributes.

REAL columns represent part expressions that also need to be present in the Part Family Template and the Part Family Table line items must match the values in these fields in the DATA section.

STRING columns will be automatically populated based on the values in the DATA section



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PTB Files APPLIED Sections

```
APPLIED
      NAME       DESCRIPTION
      FORMAT         Pipe []-NPS-[]-OD1-Seamless-ASME B36.10-10-AISI_310_SS (Grd P5)
      COLUMNS        NPS    OD1
END_OF_APPLIED
```

Creates the part/stock attribute DESCRIPTION using the values of NPS and OD1 from the DATA section

```
APPLIED
      NAME       OD
      FORMAT         []
      COLUMNS        OD1
END_OF_APPLIED
```

Creates the part/stock attribute OD using the value of OD1

```
APPLIED
      NAME       WALL_THK
      FORMAT         []
      COLUMNS        t1
END_OF_APPLIED
```

Creates the part/stock attribute WALL_THK using the value of t1

```
APPLIED
      NAME       ISOGEN_COMPONENT_ID
      FORMAT         PIPE
END_OF_APPLIED
```

Creates the part/stock attribute ISOGEN_COMPONENT_ID and assigns the value PIPE

```
APPLIED
     NAME WEIGHT_UNITS
     FORMAT KG-METERS
END_OF_APPLIED
```

Creates the part/stock attribute WEIGHT_UNITS and assigns the value KG-METERS

```
APPLIED
      NAME       ISOGEN_SKEY
      FORMAT         PIPE
END_OF_APPLIED
```

Creates the part/stock attribute ISOGEN_SKEY and assigns the value PIPE

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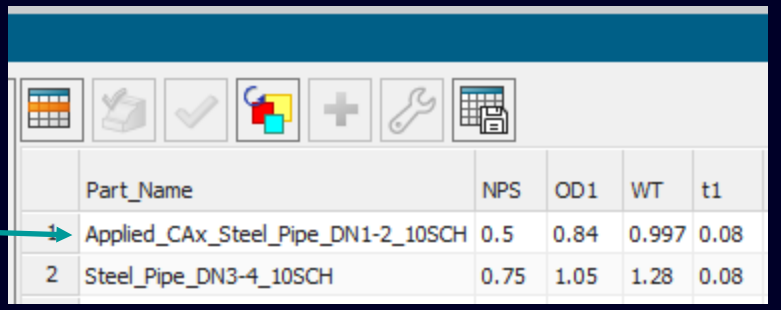
PTB File DATA Section

```
DATA
!
!MEMBER_NAME          NPS OD1 WT   t1   SCH MATERIAL     MATERIAL_CODE    PIPE_STANDARD  PART_NUMBER                                  PART_NAME
!
"Applied_CAx_Steel_Pipe_DN1-2_10SCH"   0.5 0.84    0.997    0.08    "10"    "AISI_310_SS"    "Grd P5"         "ASME B36.10"   "Does Not Need To Match MEMBER_NAME or Part_Name in PFT"   "Steel_Pipe_ASME_36.10"
"Steel_Pipe_DN3-4_10SCH"     0.75    1.05    1.28    0.08    "10"    "AISI_310_SS"    "Grd P5"         "ASME B36.10"   "Steel_Pipe_DN3-4_10SCH"     "Steel_Pipe_ASME_36.10"
```

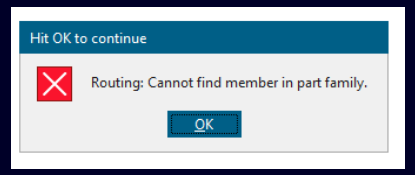
MEMBER_NAME – Uses the Part Family Table of the Template File referenced by the PTB file to locate the correct Part Family Member to be used. MEMBER_NAME attribute will be created at the Stock/Part level.

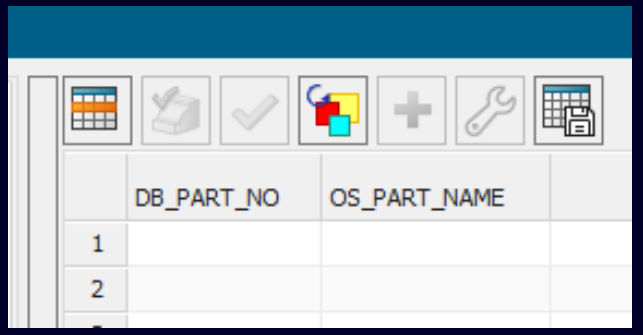
MEMBER_NAME	Applied_CAx_Steel_Pipe_DN1-2_10SCH



	Part_Name	NPS	OD1	WT	t1
1	Applied_CAx_Steel_Pipe_DN1-2_10SCH	0.5	0.84	0.997	0.08
2	Steel_Pipe_DN3-4_10SCH	0.75	1.05	1.28	0.08

The MEMBER_NAME from the DATA section must match the Part Family or NX will not be able to find the file and will report the following error.





	DB_PART_NO	OS_PART_NAME
1		
2		

PART_NUMBER – This value will be assigned to the PART_NUMBER attribute for the respective MEMBER_NAME in that row.

PART_NUMBER	Does Not Need To Match MEMBER_NAME or Part_Name in PFT

PART_NAME – This value will be assigned to the PART_NAME attribute for the respective MEMBER_NAME in that row.

PART_NAME	Steel_Pipe_ASME_36.10

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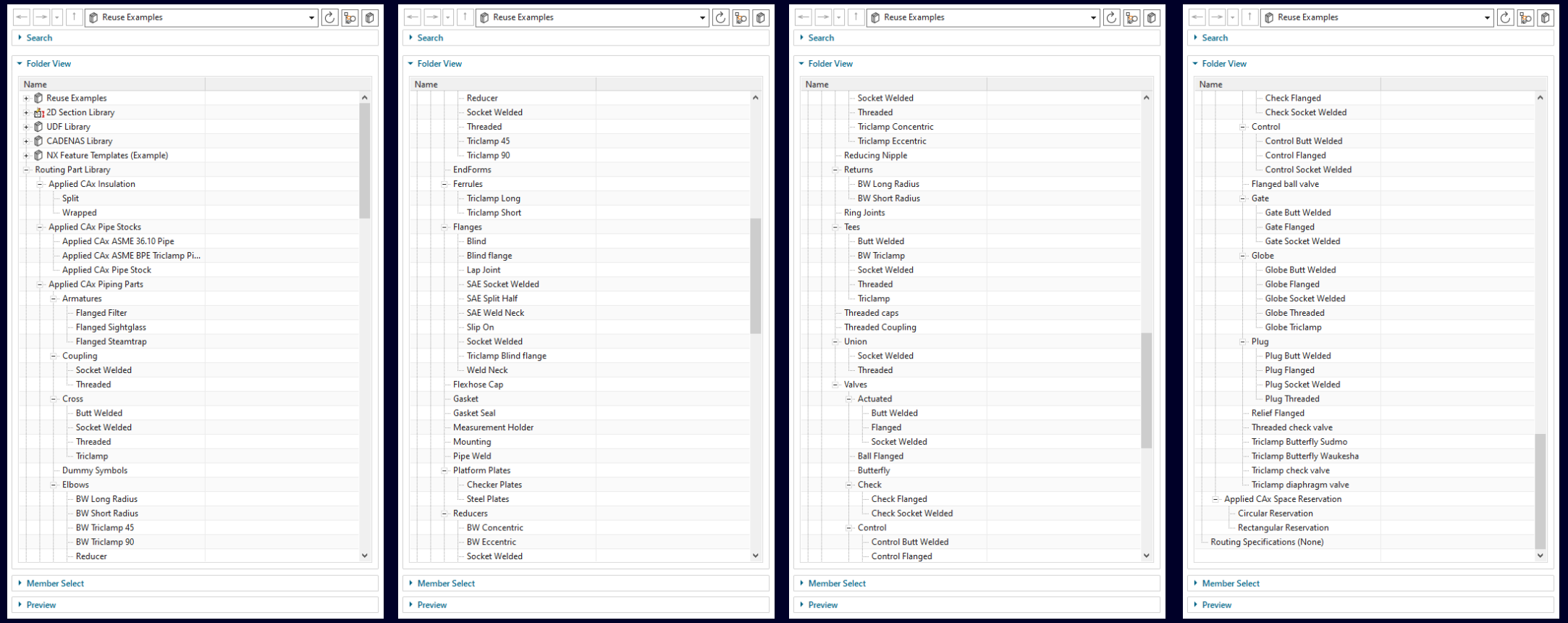
Some best practice suggestions:

- Avoid over populating - Only add what you use. ERP system can help prioritize part creation order



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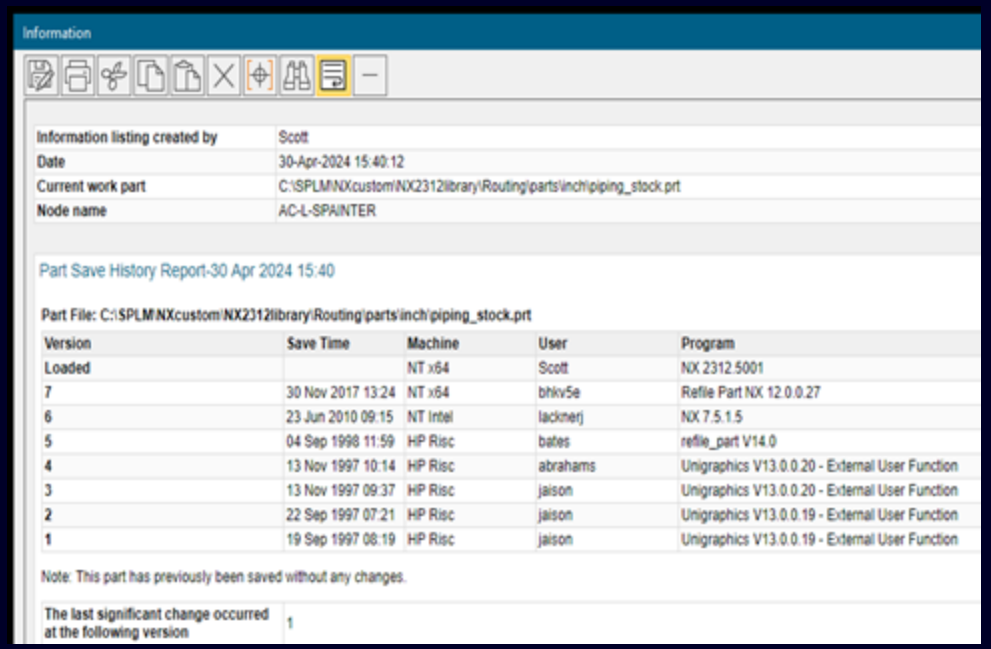
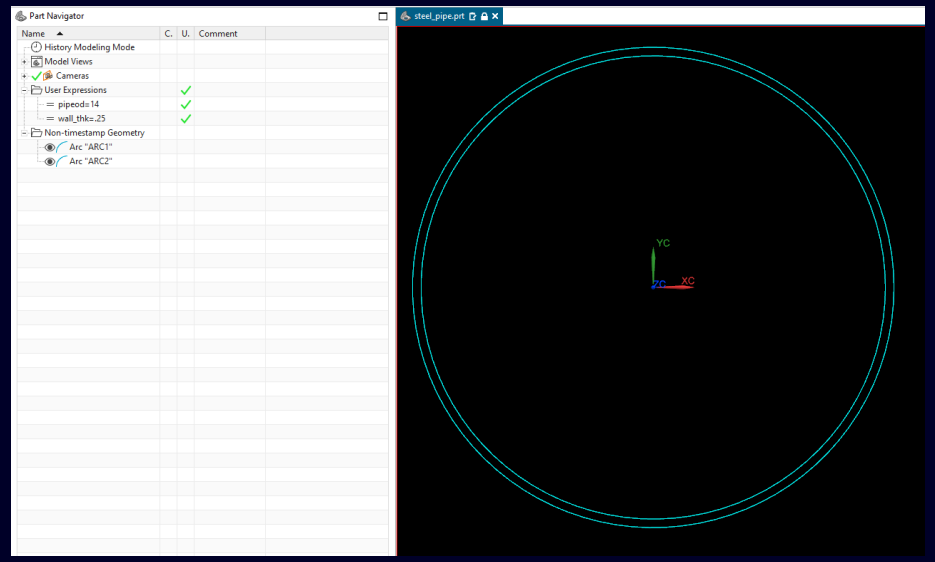
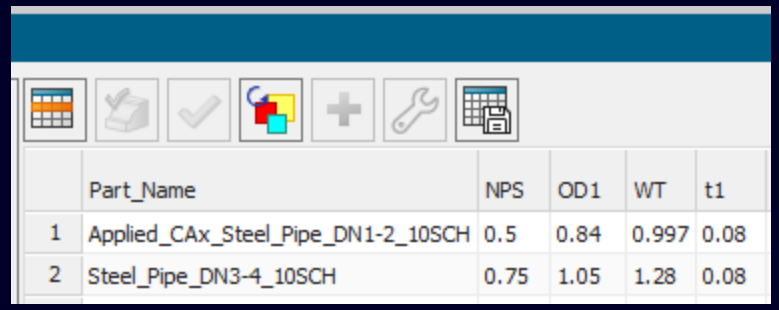
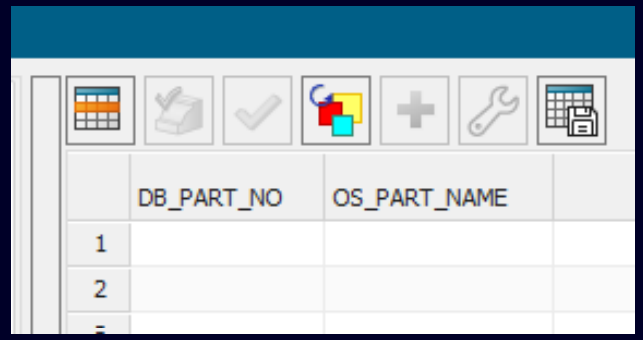
Some best practice suggestions:

- Consider creating new NX models rather than importing NX Routing library example files. Many of the part files provided OOTB were created years ago in much older versions.









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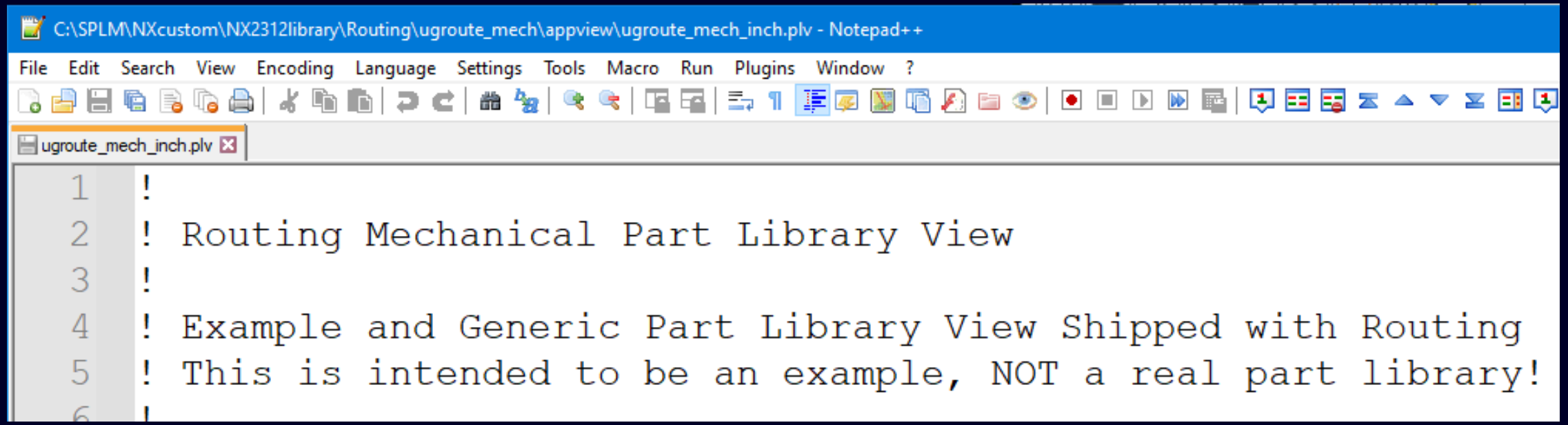
Some best practice suggestions:

- Consider creating new PLV files. Siemens mentions that all files are examples only.
- Establish a Part Librarian group.



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