



# Using ArcGIS® Schematics for Inside Plant Representation

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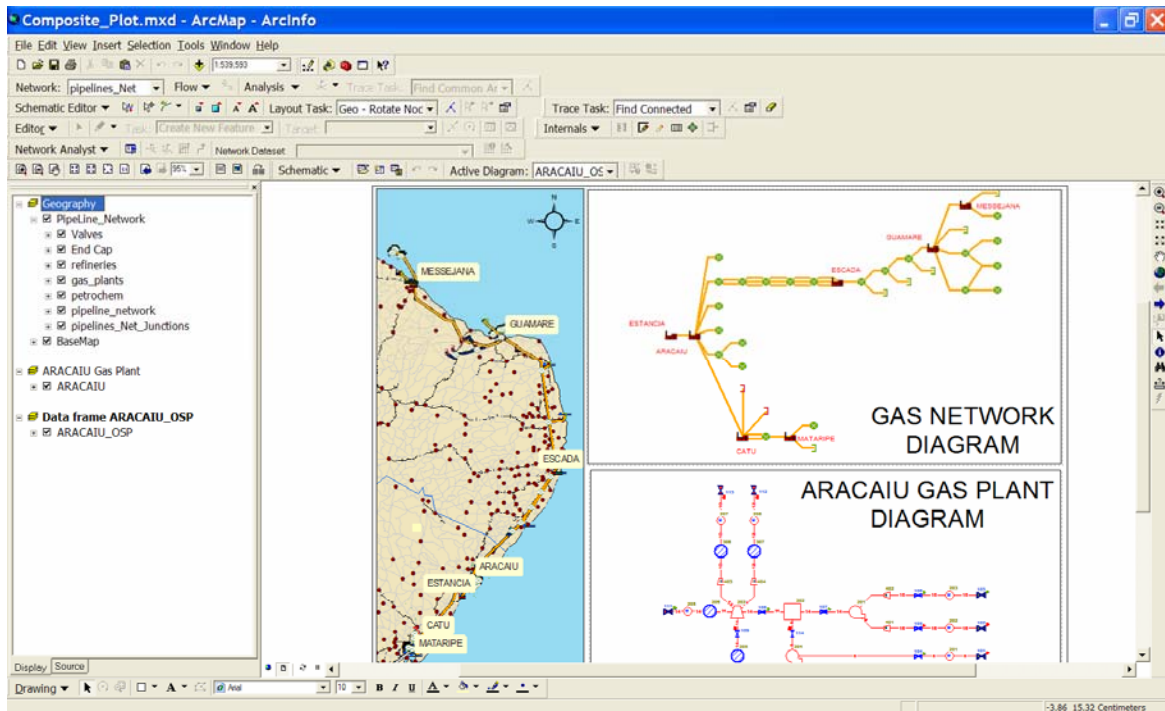
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# Using ArcGIS Schematics for Inside Plant Representation

## An ESRI Technical Paper

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# Using ArcGIS Schematics for Inside Plant Representation



## What Is "Inside Plant"?

"Inside plant" is a term that has different meanings depending on what industry is being discussed. In the electric industry, it will most likely be the inside of a substation; in the oil industry, it may be the inside of a gas plant or refinery; and in the telecommunications industry, it may be the inside of a switch cabinet—the list goes on and on. Basically, any data that has to/from node connectivity but is not normally viewable in the GIS, can be referred to as an inside plant. Follow the steps below to make a diagram showing your business' organizational chart, for example.

## How Do I Create an Inside Plant Diagram Using ArcGIS Schematics?

Each inside plant configuration will vary depending on how detailed it is or how many data sources are involved. In the following example, you will look at adding inside plant representations for a dataset from Brazil that includes gas plants and refineries.

***Starting Questions***

The following questions need to be answered before getting started:

- Where is the data that will be used to create the schematic elements for the inside plant diagrams?
- Is there to/from node connectivity in the data, or is there a way to calculate connectivity from attributes?
- What items do you want to see on the inside plant diagrams?
- Do you want interaction from ArcMap™ or just from ArcGIS® Schematics?

***Items to Create in ArcGIS Schematics***

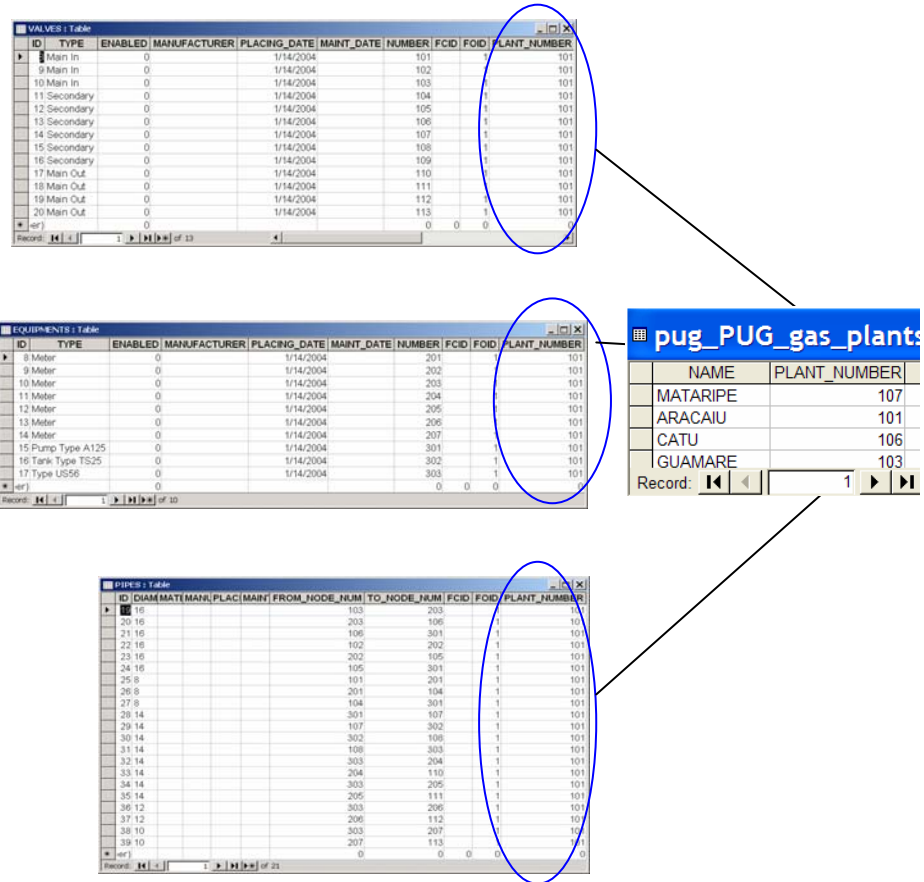
The following items will need to be created to represent the inside plant diagram with ArcGIS Schematics:

- A new data source to connect to the external data
- A new diagram type representing the inside plant
- Node and link element types to represent the items that will be displayed in the diagram
- Custom interaction, as needed

**Example**

In this example, a Microsoft Access database called ISP.mdb is used. In the following screen shot, all the tables relate to the pug\_PUG\_gas\_plants table.

J-9248



The example uses four tables:

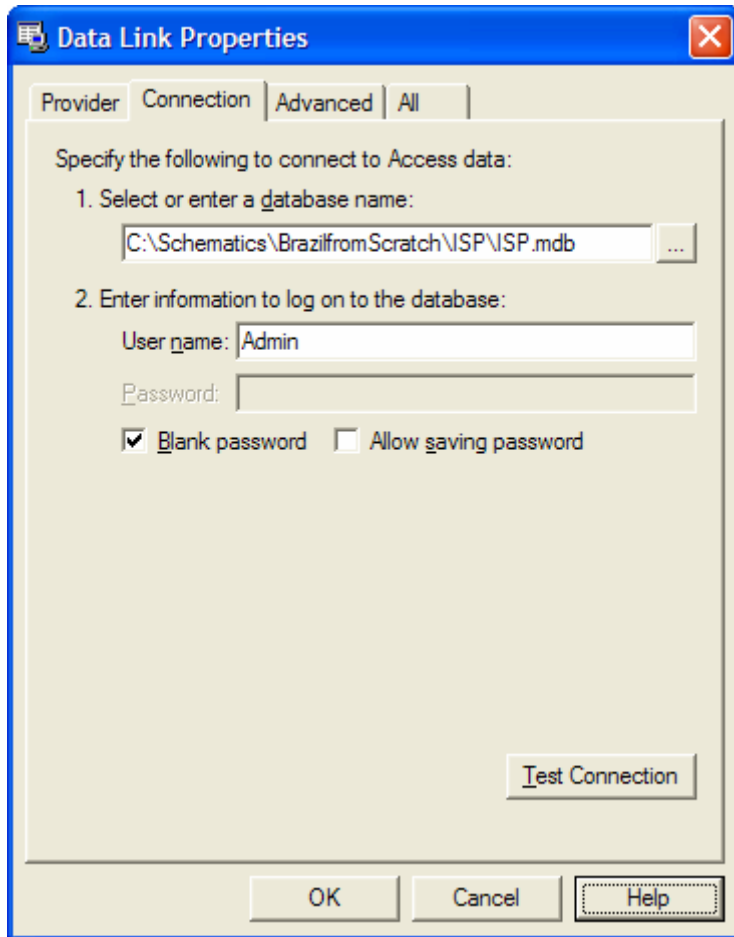
- The Equipments table holds all the internal equipment pieces. Equipment is differentiated by the Type field.
- The Valves table keeps track of the valves. Valve types are differentiated by a Type field.
- The Pipes table links all the equipment and valve pieces.
- The pug\_PUG\_gas\_plants table is the feature class representing gas plants or refineries features that are seen in ArcMap. These are the keys to both the outside world (ArcMap) and the inside world (inside plant).

You have answered all four of the questions from the Starting Questions section and have a database that contains all the items for the internal representations. The Pipes table has two columns, From\_Node\_Num and To\_Node\_Num, that define the to/from connectivity for the internals. Based on the three tables (not including the Plants table) and the Type field on the Equipments and Valves tables, you know everything you want to show on the Inside Plant diagram. You can use interaction with ArcMap because the items in the pug\_PUG\_gas\_plants table will have an outside world representation. So now you are

ready to do some work using the ArcGIS Schematics Designer application to define the parts and pieces to create the inside plant diagrams.

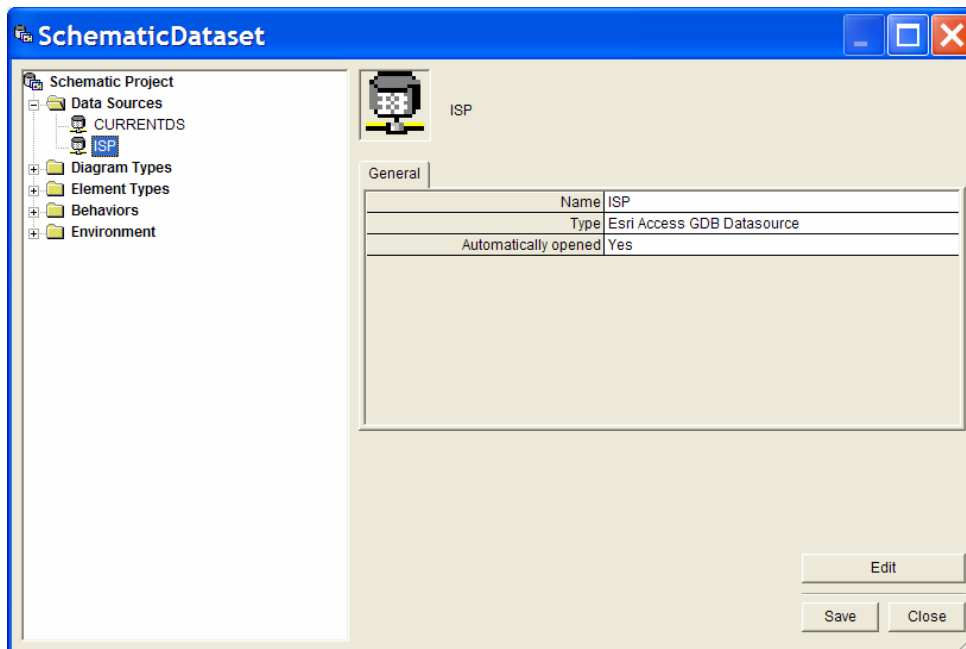
Start by either creating a new schematic dataset or using an existing one. To create a new schematic dataset, you will need to create a new personal geodatabase or use an existing one. Once you have the geodatabase ready, right-click the geodatabase and choose New>Schematic Dataset from the pop-up menu. Rename the dataset as desired. Right-click on the schematic dataset you just created and choose Edit Project from the pop-up menus. This starts the Schematics Designer application.

Now that you have the dataset, the first step in the Items to Create in ArcGIS Schematics section is to create a new data source. The data source needs to point to your database where the inside plant tables reside. Note that this could be in many databases. If that is the case, you will need to create one data source for each database. If your schematic dataset was created in the same database as the tables for the inside plant elements, then you do not need to create a new data source. Schematics automatically creates a data source called CURRENTDS that points to the database where the schematic dataset was created. If you need to create a new data source, right-click the Data Sources entry in the tree view of the Schematics Designer application and choose Add data source from the pop-up menu. ArcGIS Schematics uses Microsoft's Data Link wizard to create a connection, so depending on the database used, configure the Provider and Connection tabs accordingly, then test the connection to make sure it is running.

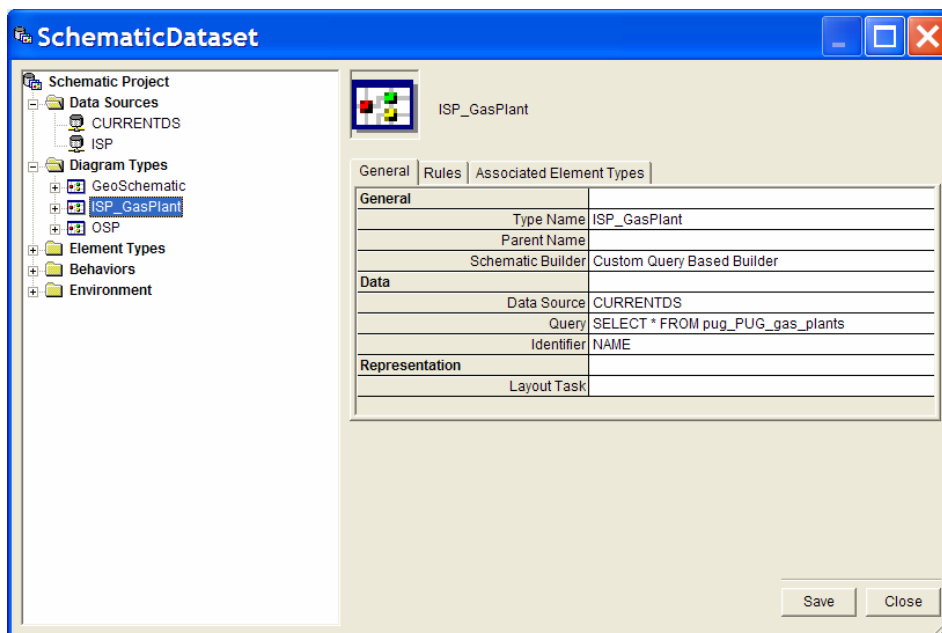


Once the connection is successful, you should have a data source available inside the Designer application. In this example, the name is ISP.



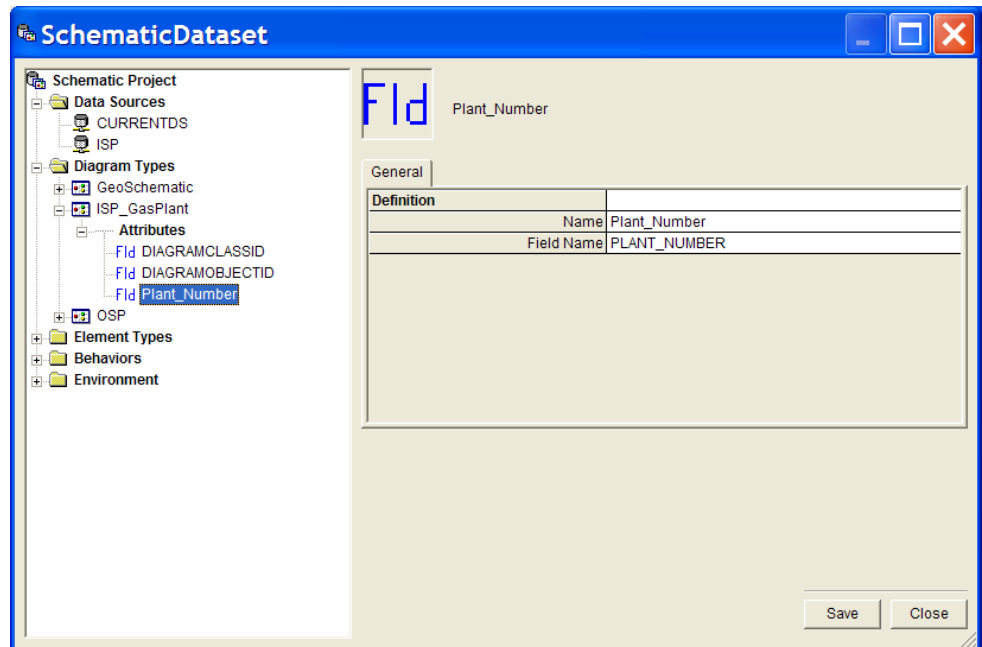


Step 2 in Items to Create in ArcGIS Schematics is to create a diagram type. Edit the dataset using the Designer application and create a new Diagram Type for inside plant diagrams. Right-click the Diagram Types entry in the tree view and choose Create from the pop-up menu. In this example, it is named ISP\_GasPlant.



Change the Schematic Builder to Custom Query Based Builder using the drop-down box. To complete the definition, set the data source to the one created in step 1, or use CURRENTDS if it is in the same database, then define a query that will return the

records from which a user may pick to view the internals selected document. In this example, we use `SELECT *FROM pug_PUG_gas_plants`. Set the Identifier, which in this example is `NAME`, a unique field in the database. If a user wanted to open an `ISP_GasPlant` diagram, he or she would be given a list of Plant names from which to choose. You need to create an attribute that will retrieve the `Plant_Number` for the selected plant. That number will be required by the element types to return just the internal objects that are related to the selected plant. (In the table diagrams above, you can see that the `Equipment`, `Valves`, and `Pipes` tables do not contain the name of the plant in which they belong, only the number of the plant.)

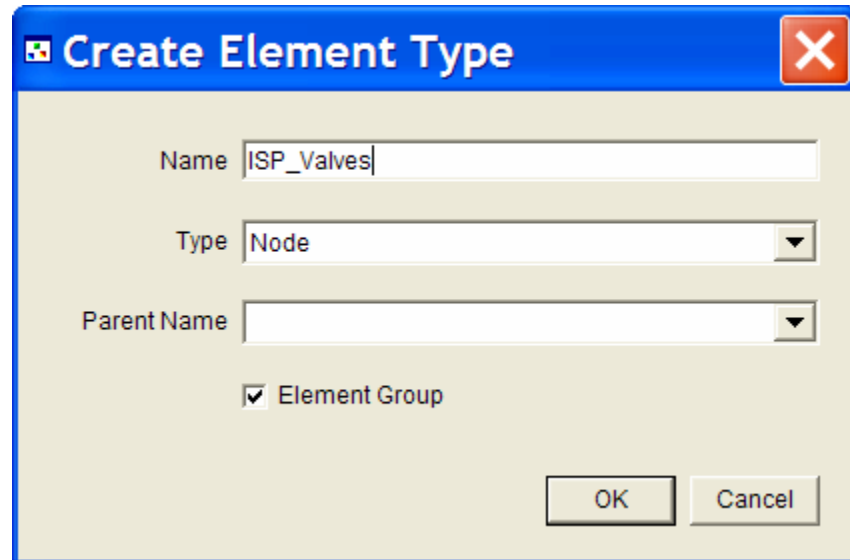


Once the element types have been successfully created, associate them to the diagram type, but for now you are done with the diagram type.

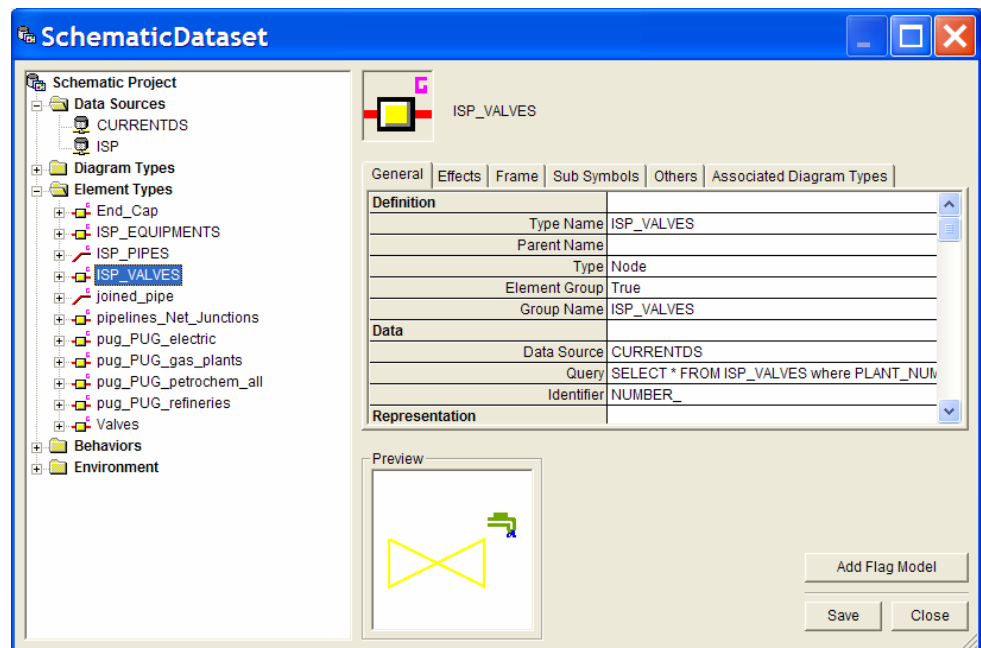
Step 3 from Items to Create in ArcGIS Schematics above is to create the element types. You will need to create an element type for each of the object types that you want to see on the diagram.

For this example, you will create one node element type and one link element type. Repeat the steps for all needed element types.

For the node element type, right-click the Element Types tree view entry and select Create. Give the new element type a name and select Node from the Type drop-down list. Click OK to see your new element type in the tree view.

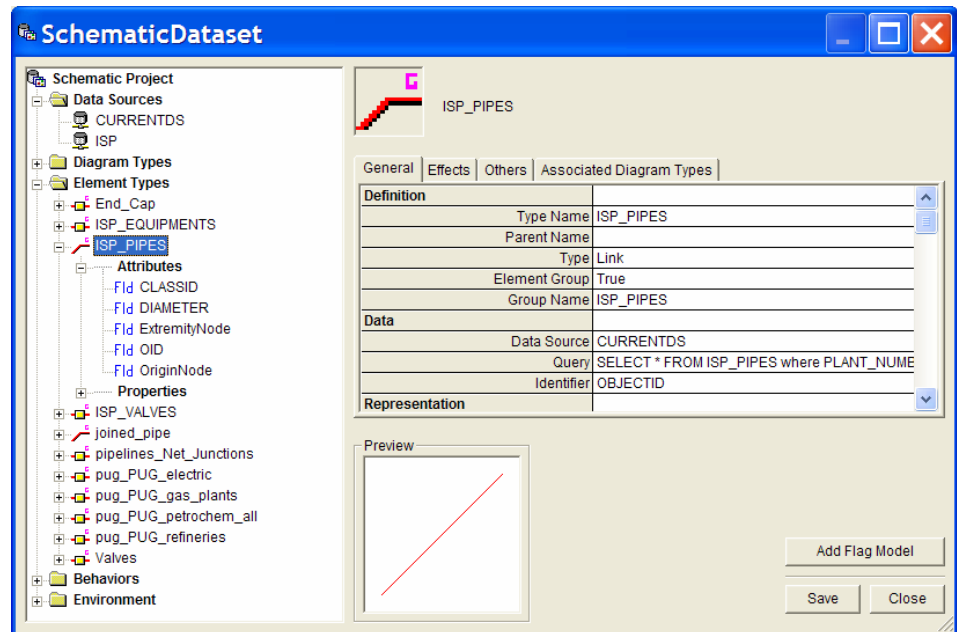


To complete the element type, you must associate the element type to the diagram type; set the data source to the correct data source; then define the query, identifier, and a symbol to use. To associate, right-click the diagram type and select Associate Element Types from the pop-up menu, then check the appropriate boxes.



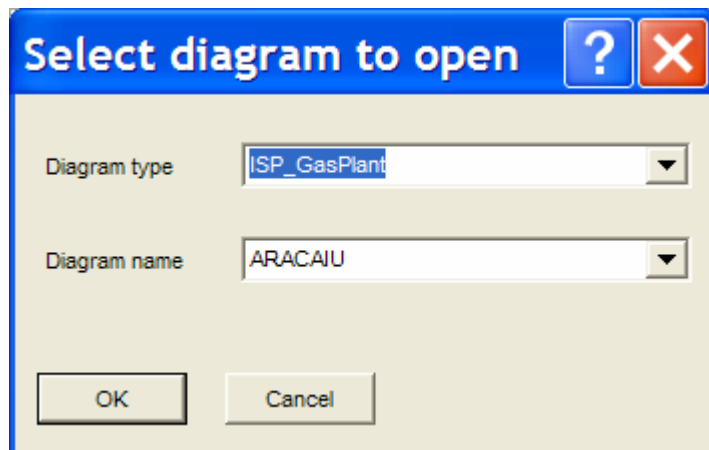
Notice that the query ends with a question mark. In the query creation screen, it has been identified that the PLANT\_NUMBER parameter will come from the attribute that you created for the diagram type Plant\_Number. You can further define the ISP\_Valves element type by defining filters for the different types of valves that are stored in the Type field of the Valves table.

Creating a link element type is the same as creating a node except that you must select Link in the Create Element Type dialog box and define a few more attributes.

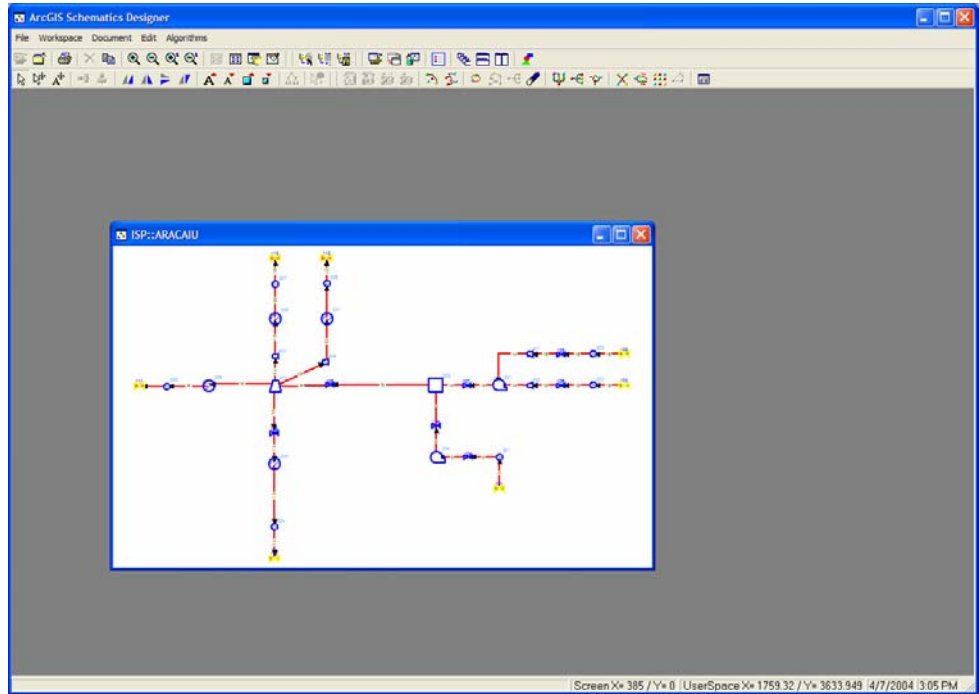


The mandatory attributes to create are ExtremityNode and OriginNode. These get set to the To\_Node\_Num and From\_Node\_Num fields in the ISP Pipes table.

You are now ready to test the application. To test, click the Open Diagrams button on the Designer's Diagram toolbar.

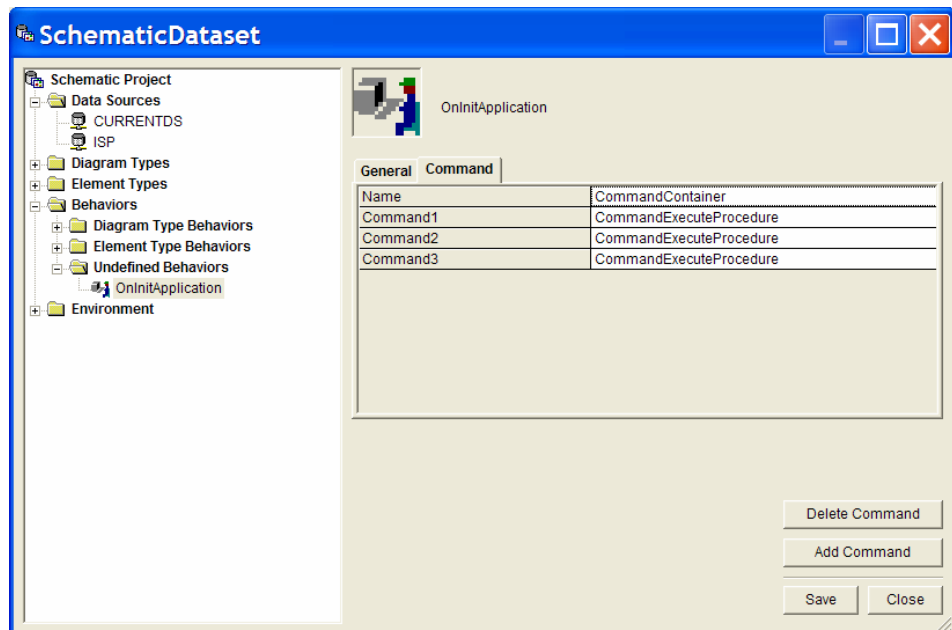


You should see ISP\_GasPlant in the Diagram type field and a list of the plant names in the Diagram name field. Select a plant and click OK. If all the steps worked, you should have your new diagram. Note that the first time a diagram is opened, the items will be placed on a grid layout. After the user moves items around, or uses a predefined layout algorithm and saves the diagram, it will then be opened as it was left from that point on.

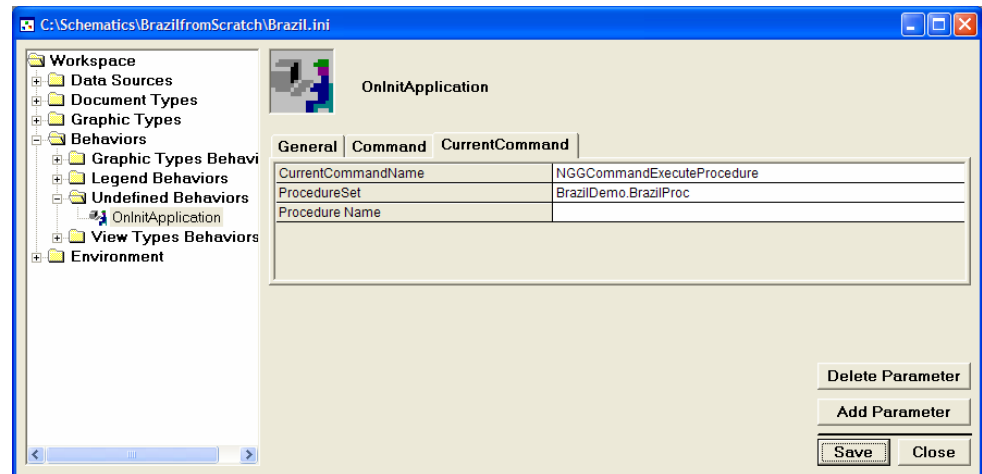


### Finishing Touches (Optional)

To finalize this example application, you need to create the diagram from a selection inside of ArcMap. You create a simple DLL using Visual Basic to handle the opening of a new diagram, then write VBA code in ArcMap to call the Visual Basic DLL. Any custom DLL that you want to create and add to a Schematics application requires that the DLL be initialized by the Schematics session. To do that, using the Designer, open the tree view to OnInitApplication, select the Command tab, and click the Add Command button. Select CommandExecuteProcedure from the drop-down list.



Select the CurrentCommand tab and fill in the details of your DLL. In this case, it should look like the following:



Do not put in a Procedure Name at this point. Schematics automatically calls the Initialize routine of the DLL to pass a handle to the current workspace. You can see this in the code sections below.

### The VBA Code

You need to paste the following code into the VBA environment of ArcMap. (You can see that the code gets invoked when someone right-clicks in ArcMap. It checks to see if any of the selected features are refineries or gas plants. If they are, it calls a Visual Basic function, passing it the name of the plant and the diagram type name. The function then creates the diagram.)

```
Private Function MxDocument_OnContextMenu(ByVal x As Long, ByVal y As Long) As Boolean
```

```
On Error GoTo errhandler
```

```
Dim pMxDoc As IMxDocument 'Document object
```

```
Dim pMap As IMap 'actual map
```

```
Dim pEnumFeature As IEnumFeature
```

```
Dim pEnumFeatureSetup As IEnumFeatureSetup
```

```
Dim pFeature As IFeature
```

```
Dim featureClassName As String
```

```
Dim esriWorkspace As esriGeoDatabase.IWorkspace
```

```
Dim pDS As esriGeoDatabase.IDataset
```

```
Dim schProject As INgProject 'Main Schematics project
```

```
Dim schWrkFct As ISchematicWorkspaceFactory
```

```
Dim schWrk As ISchematicWorkspace
```

```
Dim schDS As ISchematicDataset
```

```
Dim schNgWrkMgr As ISchematicProjectMgr
```

```
Dim schDiagramType As INgDiagramType
```

```
Set pMxDoc = Application.Document 'get the current ArcMap document object
```

```
Set pMap = pMxDoc.FocusMap 'get the current map in focus
```

```
Set pEnumFeature = pMap.FeatureSelection 'get all currently selected features
```

```
Set pEnumFeatureSetup = pEnumFeature
pEnumFeatureSetup.AllFields = True
Set pFeature = pEnumFeature.Next 'get the first feature in the enumeration

If pFeature Is Nothing Then Exit Function ' no selected feature

Set pDS = pFeature.Class
Set esriWorkspace = pDS.Workspace ' get the feature workspace

' Get the schematic workspace corresponding to the feature workspace
Set schWrkFct = New SchematicWorkspaceFactory
Set schWrk = schWrkFct.Open(esriWorkspace)

Set schDS = schWrk.SchematicDatasetByName("SchematicDataset") 'open
the predefined Schematic Dataset where are stored the ISP diagram definition
If schDS Is Nothing Then Exit Function

Set schNgWrkMgr = New SchematicProjectMgr 'get the manager object to
switch to the low level
Set schProject = schNgWrkMgr.OpenFromSchematicDataset(schDS) 'open
the low level schematic project

Set schDiagramType = schProject.GetDiagramType("ISP_GasPlant") ' get the
diagram type to open
If schDiagramType Is Nothing Then Exit Function

Do While (Not pFeature Is Nothing) 'loop through the features
featureClassName = Mid(pDS.Name, 9)
If featureClassName = "refineries" Or featureClassName = "gas_plants" Then
'see if this is a refineries or gas_plants object
Dim indName As Integer
Dim ISPName As String

indName = pFeature.Fields.FindField("NAME") 'find out which field is the
Name column
ISPName = pFeature.Value(indName)

' Open the diagram ( Add a dataframe and a schematic layer in the
MxDocument)
schProject.OpenDiagram schDiagramType, ISPName

End If
Set pFeature = pEnumFeature.Next
Loop
MxDocument_OnContextMenu = False 'allow the right click menu to still work
Exit Function
errhandler:

'MsgBox Err.Description
End Function
```

*The Visual Basic  
DLL Code*

You will need to create a DLL and compile it with the same name for all this to work, so this is the code from the BrazilProc class of the BrazilDemo DLL.

```
Option Explicit
Private WithEvents m_NgProject As esriSchematic.NgProject
Private m_IProject As esriSchematic.INgProject
Private m_NgProjectBuilder As esriSchematic.INgProjectBuilder
Private m_NgProjectAlgorithm As esriSchematic.INgProjectAlgorithm
```

This is the standard initialize statement for custom code used by Schematics  
Public Sub Initialize(ByVal ngoProject As esriSchematic.INgProject).

```
Set m_NgProject = ngoProject
Set m_IProject = ngoProject
Set m_NgProjectBuilder = ngoProject
Set m_NgProjectAlgorithm = ngoProject
Set colElementTypes = New Collection
End Sub
```

This function allows the opening of a diagram by sending in the diagram type name and the diagram name.

```
Public Function OpenDiagram(ByVal DiagramType As String, ByVal
DiagramName As String)
On Error GoTo errhandler
Dim doc As NgDiagram
Dim curDoctype As INgDiagramType 'create a document type object

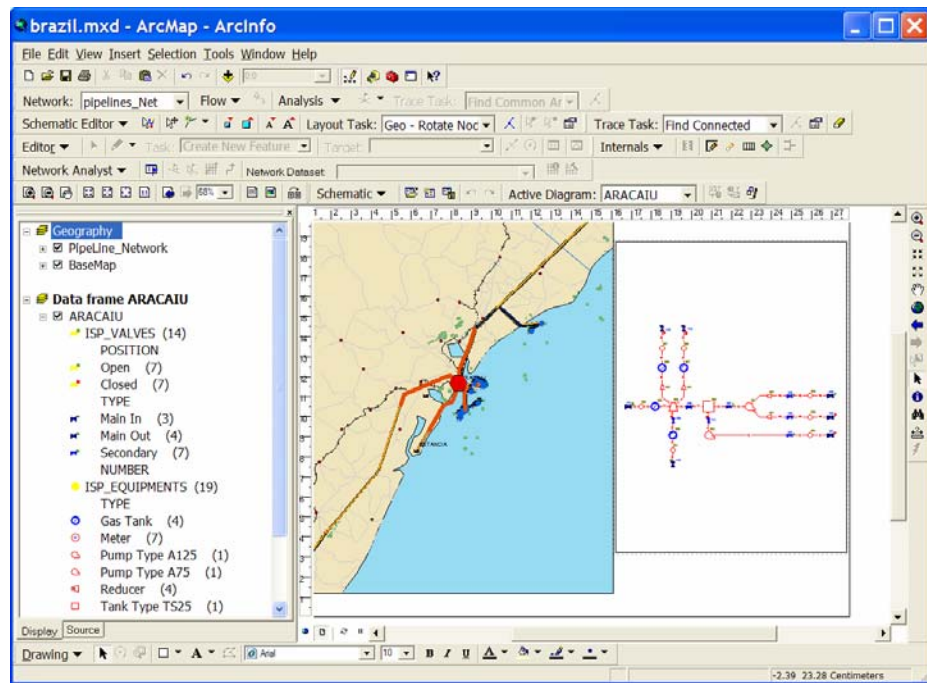
Set curDoctype = m_IProject.GetDiagramType(DiagramType) 'set it to a
specific document type
Set doc = curDoctype.OpenDiagram(DiagramName) 'Open the document you
want

Exit Function
errhandler:
MsgBox Err.Description
End Function
```

**Final Testing**

Once the Visual Basic DLL and VBA codes are in place, the only operation left to do is test. Select one of the refineries or gas plants and right-click it. This should start the VBA code, which calls Visual Basic and generates an inside plant diagram.





**Additional Information**

To get more information on this topic, use the Schematics.CHM help file located in the Help directory of your ArcGIS installation and reference the main topic titled "Starting your schematic project conception with the Custom Query Based Builder."



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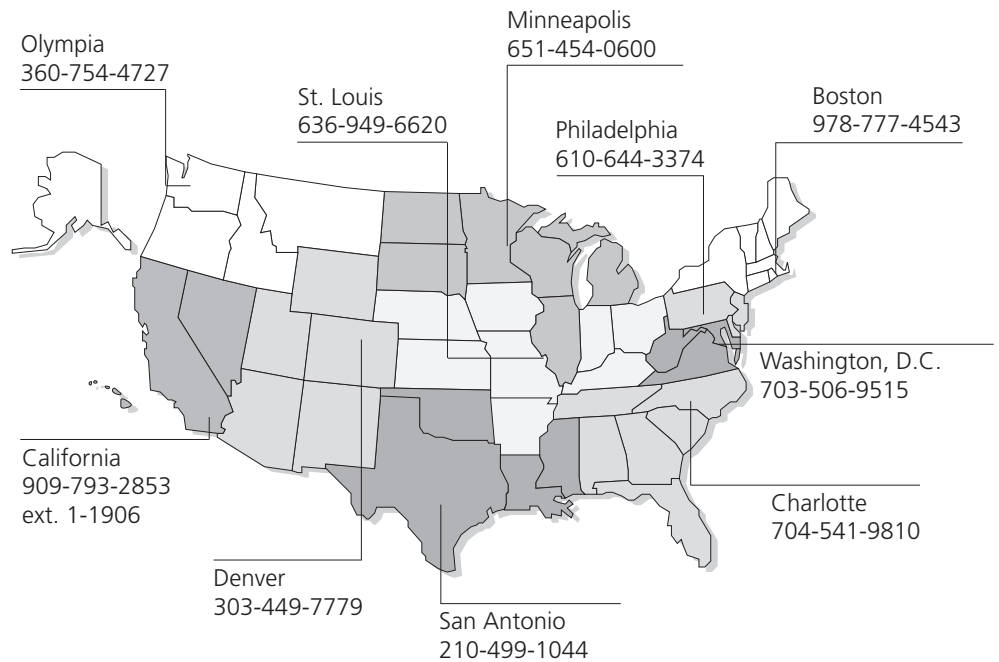
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