PowerWorld User Group 2019

Adam Sylvia – New Guy, New Perspective

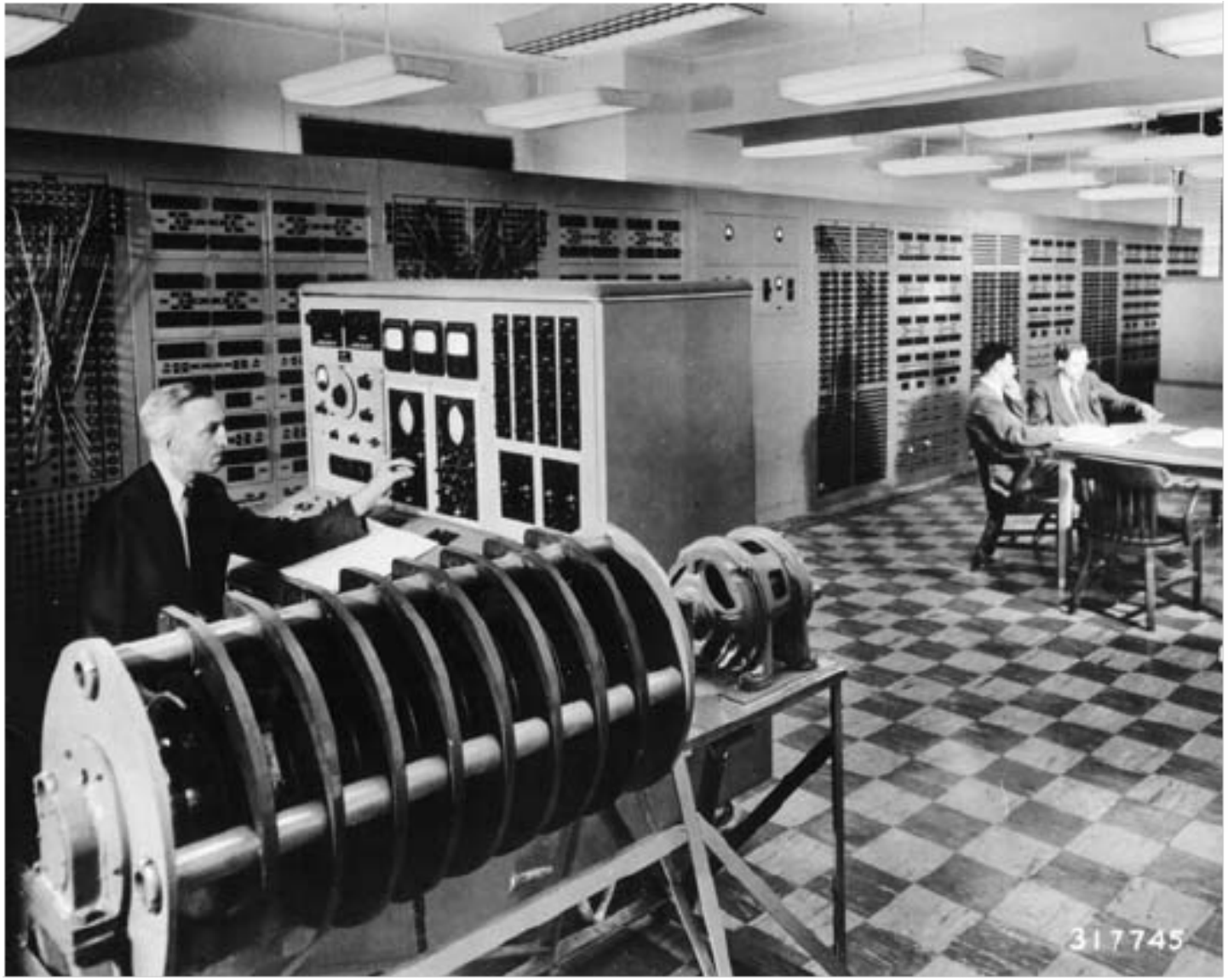
EASTERN
WASHINGTON UNIVERSITY

start something **big**

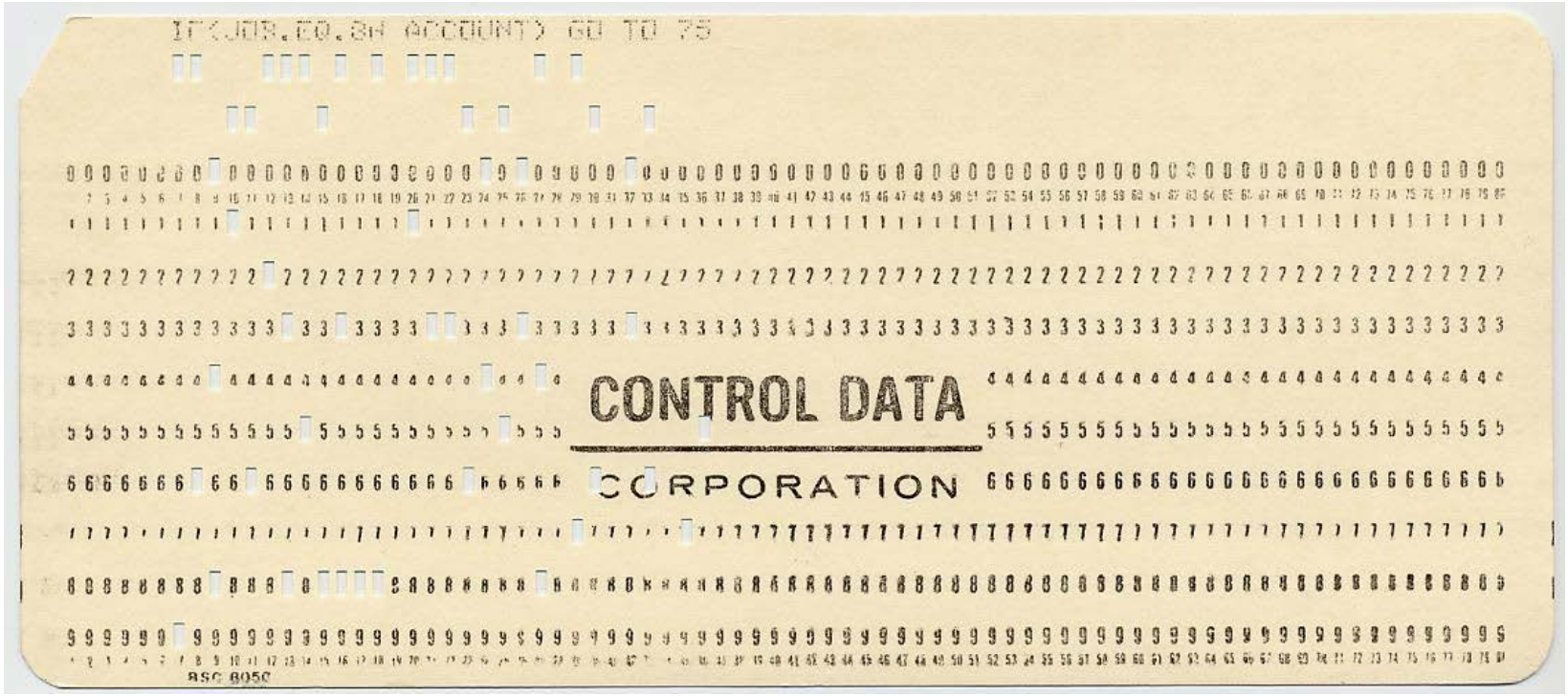
AVISTA®

AVISTA

Power Flow History – Network Analyzer

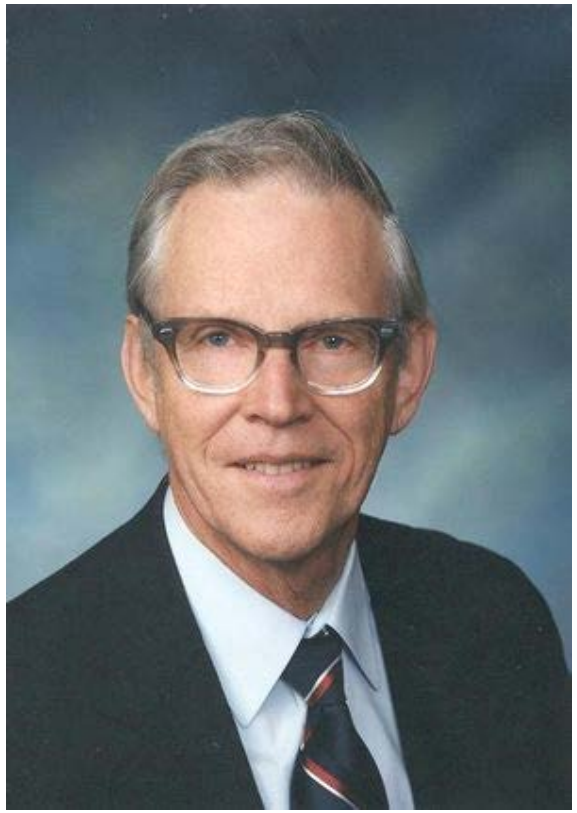


Power Flow History – Digital Computers (Punch Cards)



Power Flow History – William Tinney

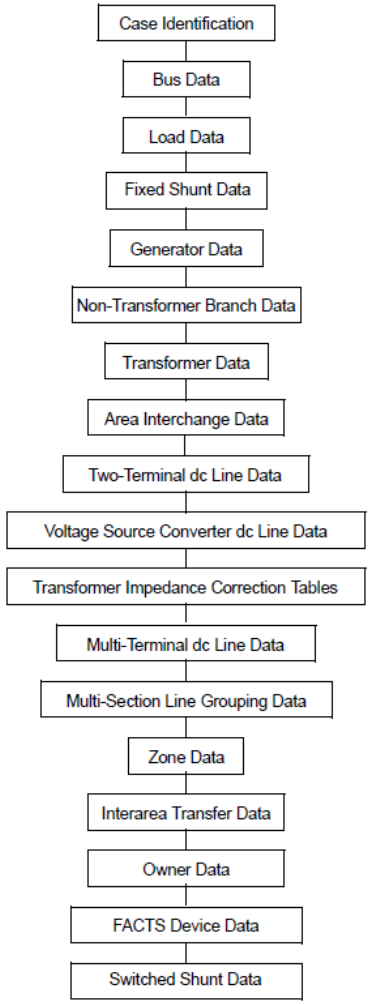
- Formulated a fast and efficient way for real-time monitoring and analysis of the power grid.



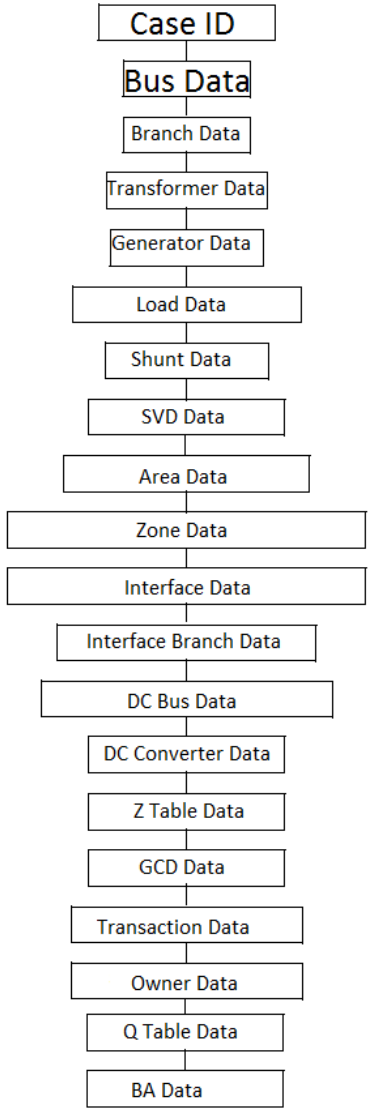
https://www.bpa.gov/news/newsroom/Pages/Long-retired-BPA-engineers-achievement-lasts-a-lifetime.aspx

Data is IMPORTANT!

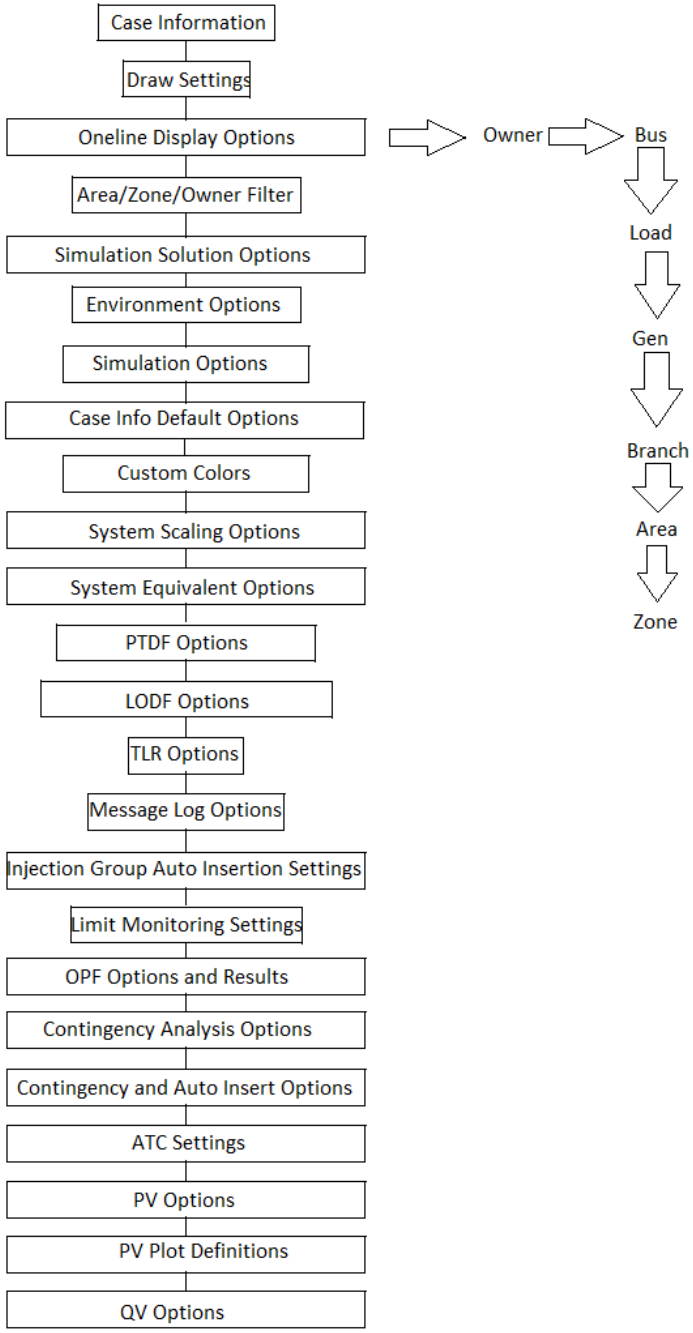
- Flat file – A database stored as an ordinary unstructured file, can be text or binary.
  - PSS/E: PTI RAW (*.raw)
  - PSLF: Electrical Power Consultants (*.epc)
  - PowerWorld: Auxiliary (*.aux)



PSS/E



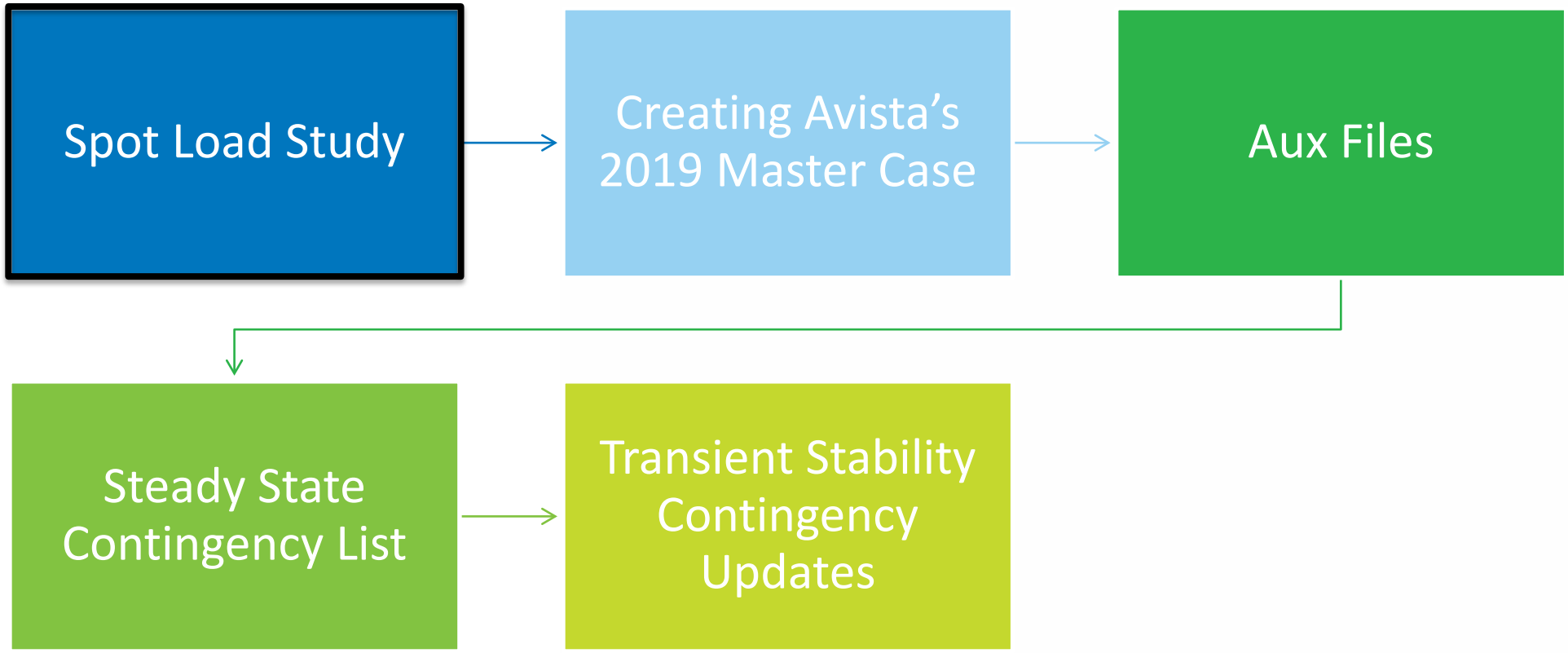
PSLF



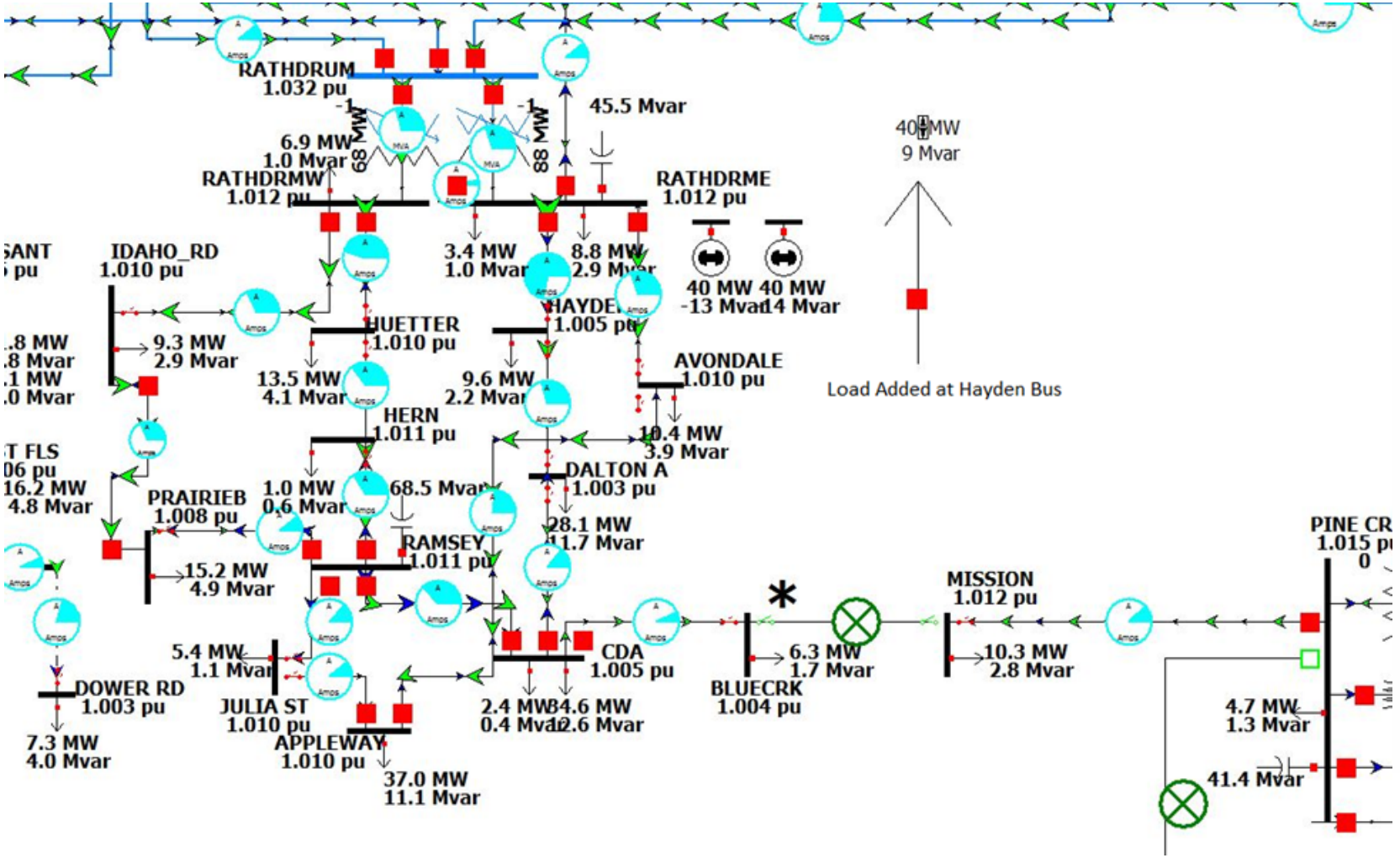
PowerWorld Simulator

PowerWorld Simulator – The Mac Daddy

- Tom Overbye developed in early 1990s for educational purposes.
- Eventually became successful in the commercial industry.
- Popularized because of simplicity, visualization and product support.


Spot Load Study
Creating Avista's 2019 Master Case
Aux Files
Steady State Contingency List
Transient Stability Contingency Updates

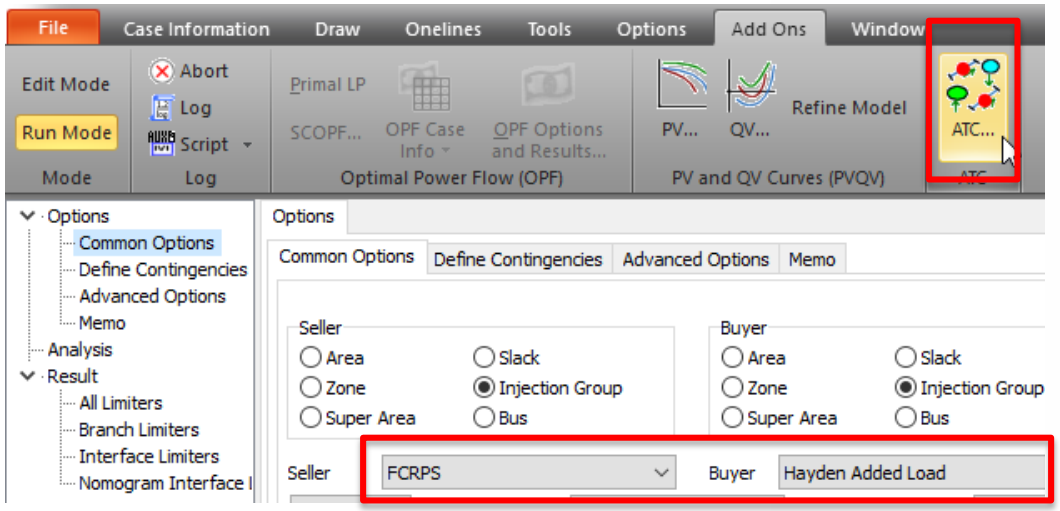
Spot Load at Hayden



The Slack Bus Matters

- Federal Columbia River Power System (FCRPS).

ATC Tool - A Good Place to Start



Trans Lim	Limiting Element	Limiting CTG	% OTDF	Pre-Trans Est	Limit Used
1027.89	POWERFLOW DIVERGENCE	BF: A505 Rathdrum East 115 kV, Coeur dAlene 15th St-Rathdrum	0	0	0
1027.89	Line BLANCHRD (48043) TO HOODOO (47505) CKT 1 [115.00 - 115.00 kV]	BF: A505 Rathdrum East 115 kV, Coeur dAlene 15th St-Rathdrum	177.37	120.4	123.7
1018.87	Line BLANCHRD (48043) TO NEWPORTT (48258) CKT 1 [115.00 - 115.00 kV]	BF: A505 Rathdrum East 115 kV, Coeur dAlene 15th St-Rathdrum	-177.37	-120.49	-123.7
1018.87	POWERFLOW DIVERGENCE	BF: A505 Rathdrum East 115 kV, Coeur dAlene 15th St-Rathdrum	0	0	0
977.89	POWERFLOW DIVERGENCE	BF: A505 Rathdrum East 115 kV, Coeur dAlene 15th St-Rathdrum	0	0	0
977.89	Line NEWPORTT (48258) TO PINE ST (47086) CKT 1 [115.00 - 115.00 kV]	BF: A505 Rathdrum East 115 kV, Coeur dAlene 15th St-Rathdrum	-177.37	-116.49	-119.7
119.43	Line HERN (48155) TO HUETTER (48159) CKT 1 [115.00 - 115.00 kV]	BUS: Rathdrum East 115 kV	-43.26	-119.78	-119.7
112.16	Transformer PINE CRK (48317) TO PINE CRK (48315) CKT 2 [230.00 - 115.00 kV]	BF: A624 Rathdrum East & West 115 kV	41.43	128.23	128
108.59	Line DALTON A (48093) TO HAYDEN (48148) CKT 1 [115.00 - 115.00 kV]	BF: A506 Rathdrum 115 kV, Pine Street-Rathdrum	100	61.15	119.7
108.59	Line DALTON A (48093) TO HAYDEN (48148) CKT 1 [115.00 - 115.00 kV]	BUS: Rathdrum East 115 kV	100	61.15	119.7

	CTG Aborted Iterated or CTG Fail Iterated
	Indicates the Transfer limitations that were iterated on
	Powerflow Divergence or Ramp Fail in Full
	CTG Fail in Base

Contingency Analysis

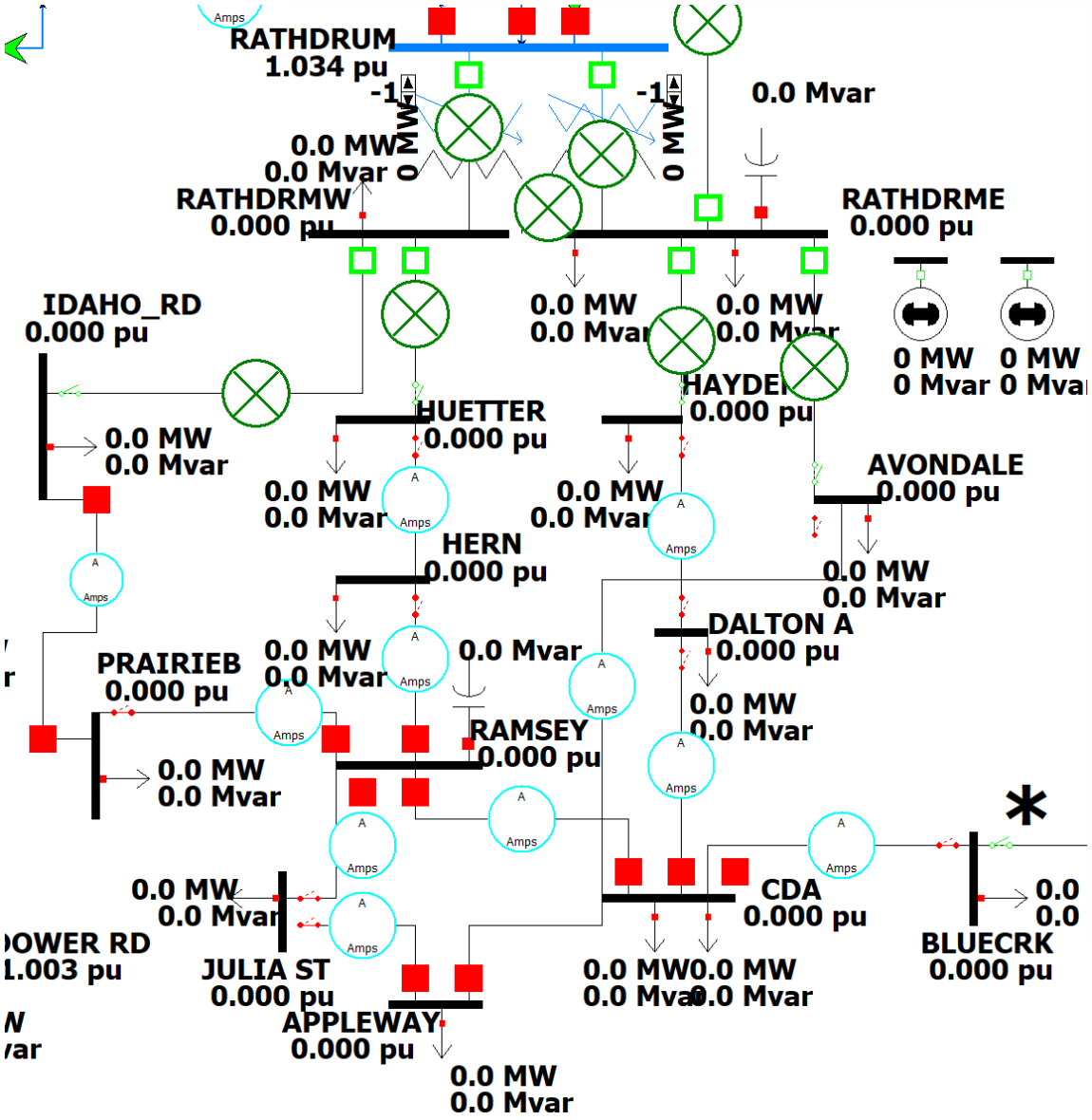
Scenario 1

	Label	Skip	Category	Violations	Custom Monitor Violations	Max Branch	Max Volt	Min Volt
1	BF: A624 Rathdrum East & West 115 kV	NO	P2	27	5	267.4		0.837
2	BF: GB1250 Sand Dunes 115 kV, Larson-Sand Dunes-Warden	NO	P2	16	1	192.4		0.909
3	N-2 (ROW): Conkelley - Libby 230 kV and Flathead - Hot Springs 230 kV	NO	SSEE-2b	4	2	174.0		

Scenario 2

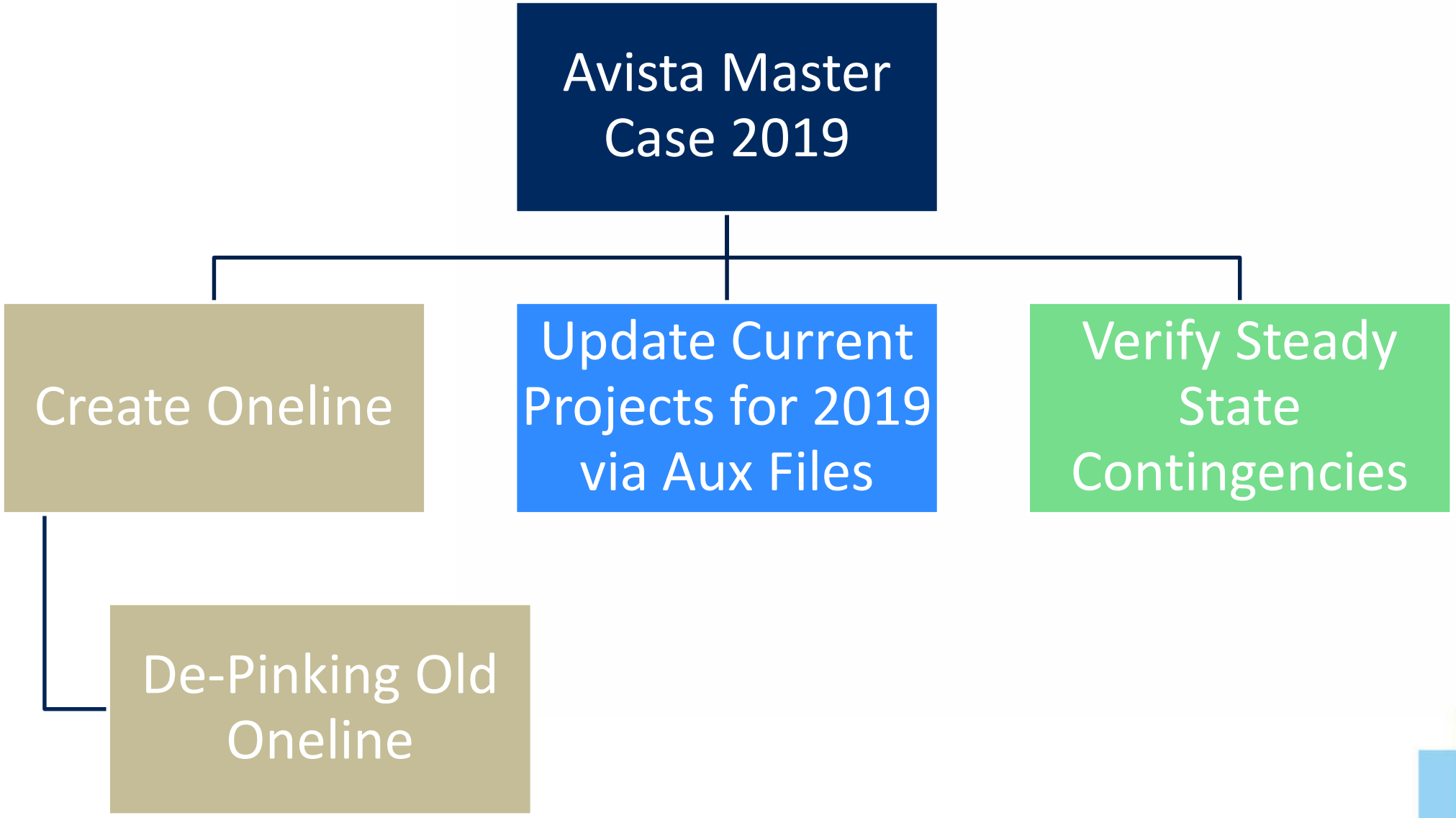
Label	Skip	Categ	Violations	Custom Monitor Violations	Max Branch %	Max Volt	Min Volt	Total Dropped Load
BF: A624 Rathdrum East & West 115 kV	NO	P2	0	1				241.60

Ah Ha!

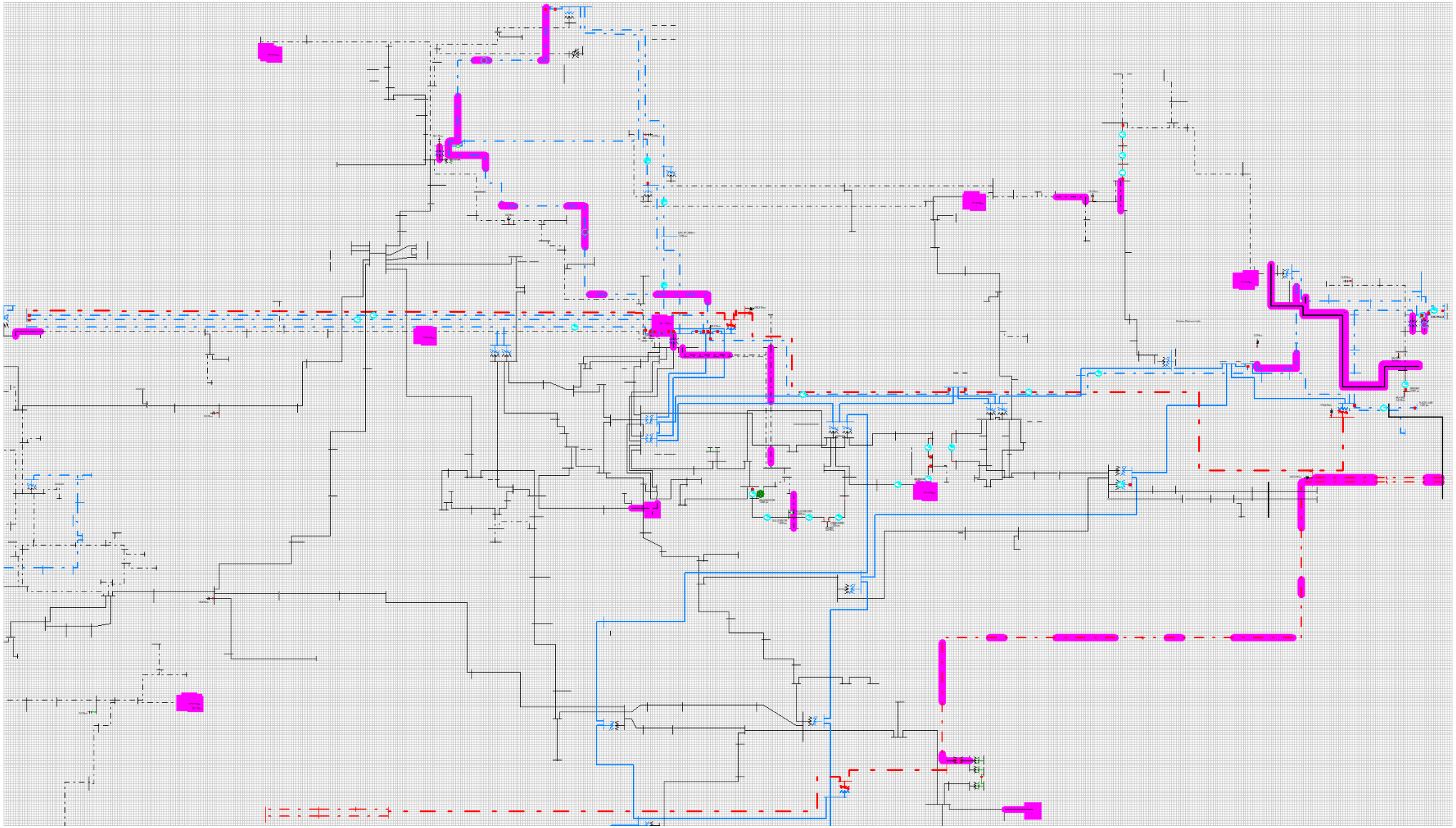

RATHDRUM
1.034 pu
-1
0 MW
0.0 MW
0.0 Mvar
-1
0 MW
0.0 Mvar
RATHDRMW
0.000 pu
RATHDRME
0.000 pu
IDAHO_RD
0.000 pu
0.0 MW
0.0 Mvar
HUETTER
0.000 pu
0.0 MW
0.0 Mvar
0.0 MW
0.0 Mvar
HAYDEN
0.000 pu
0 MW
0 Mvar
0 MW
0 Mvar
AVONDALE
0.000 pu
0.0 MW
0.0 Mvar
HERN
0.000 pu
0.0 MW
0.0 Mvar
0.0 MW
0.0 Mvar
DALTON A
0.000 pu
0.0 MW
0.0 Mvar
PRAIRIEB
0.000 pu
0.0 MW
0.0 Mvar
0.0 Mvar
RAMSEY
0.000 pu
0.0 MW
0.0 Mvar
CDA
0.000 pu
0.0 MW
0.0 Mvar
JULIA ST
0.000 pu
APPLEWAY
0.000 pu
0.0 MW
0.0 Mvar
0.0 MW
0.0 Mvar
0.0 MW
0.0 Mvar
BLUECRK
0.000 pu
0.0
0.0
Amps

Avista 2019 Master Case

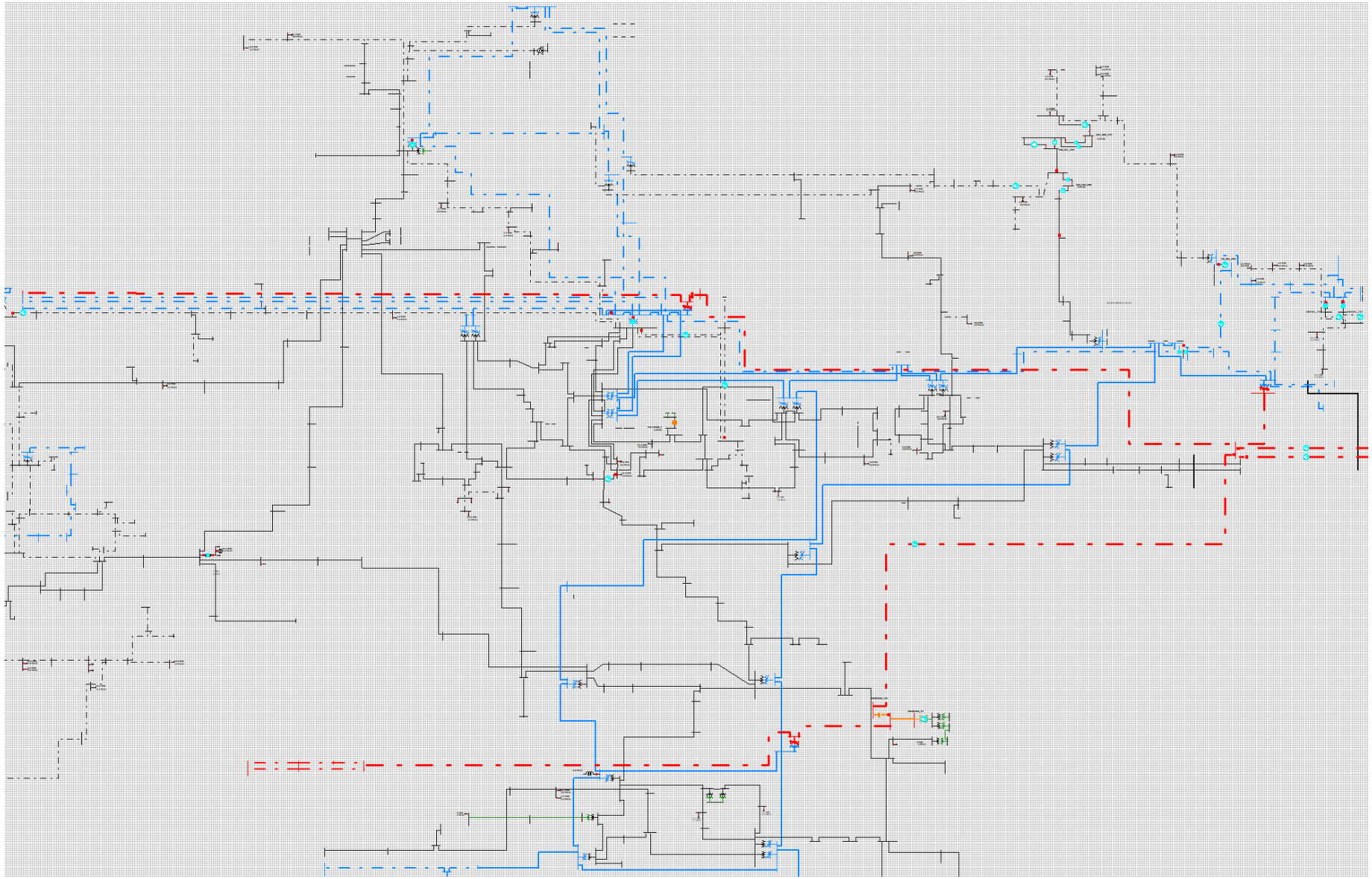
Avista 2019 Master Case



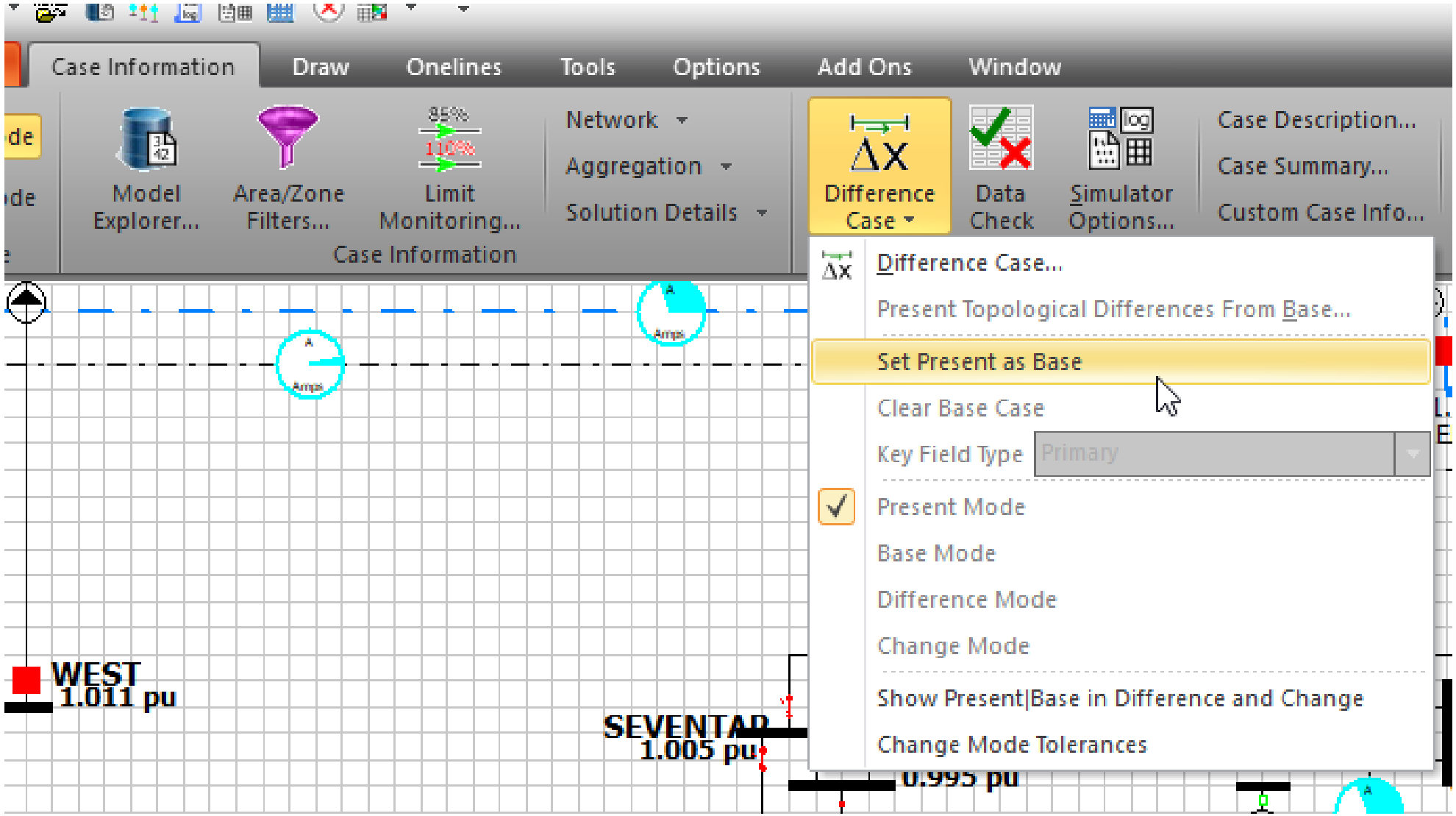
Square One…line



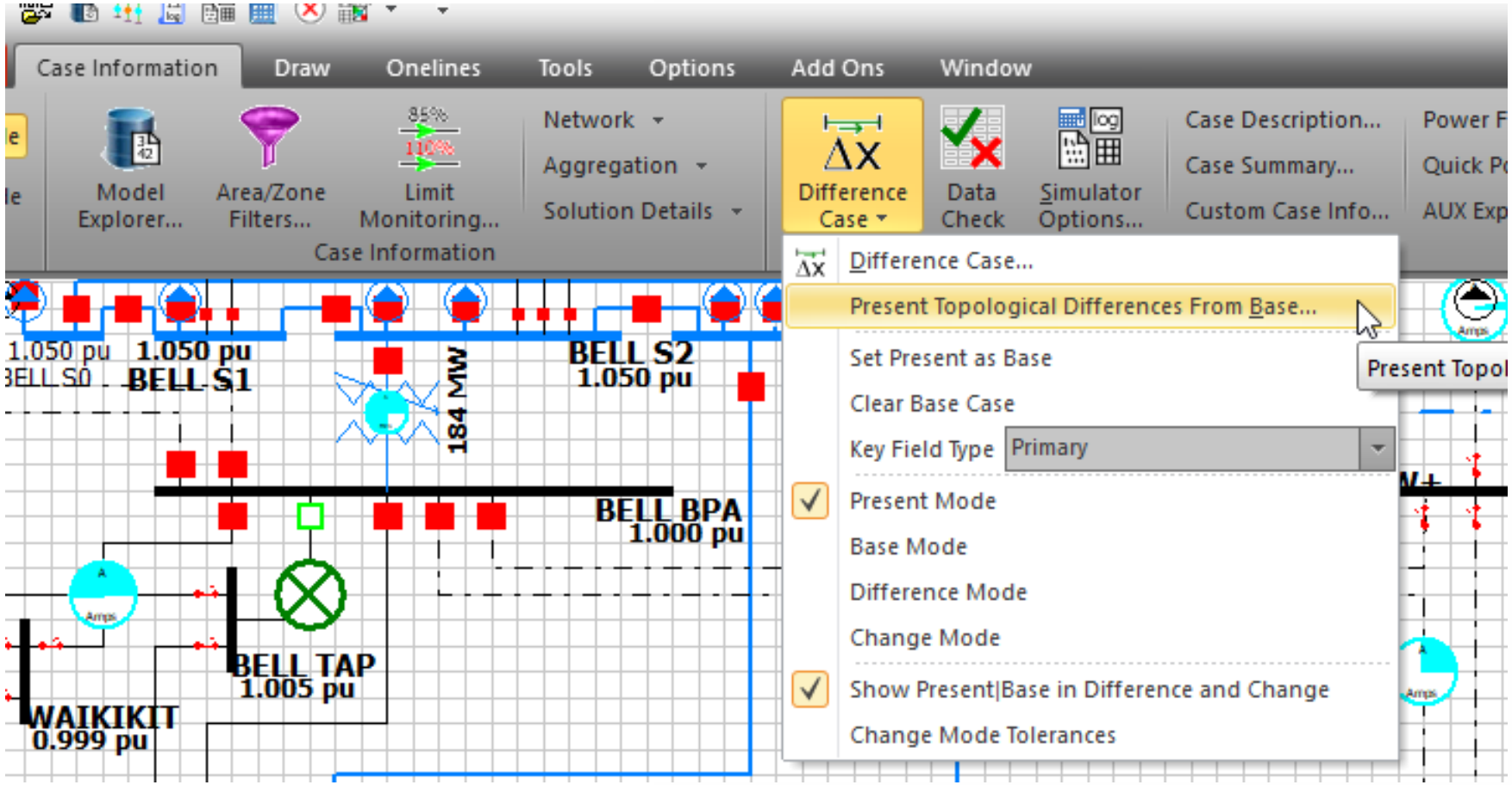
Oneline



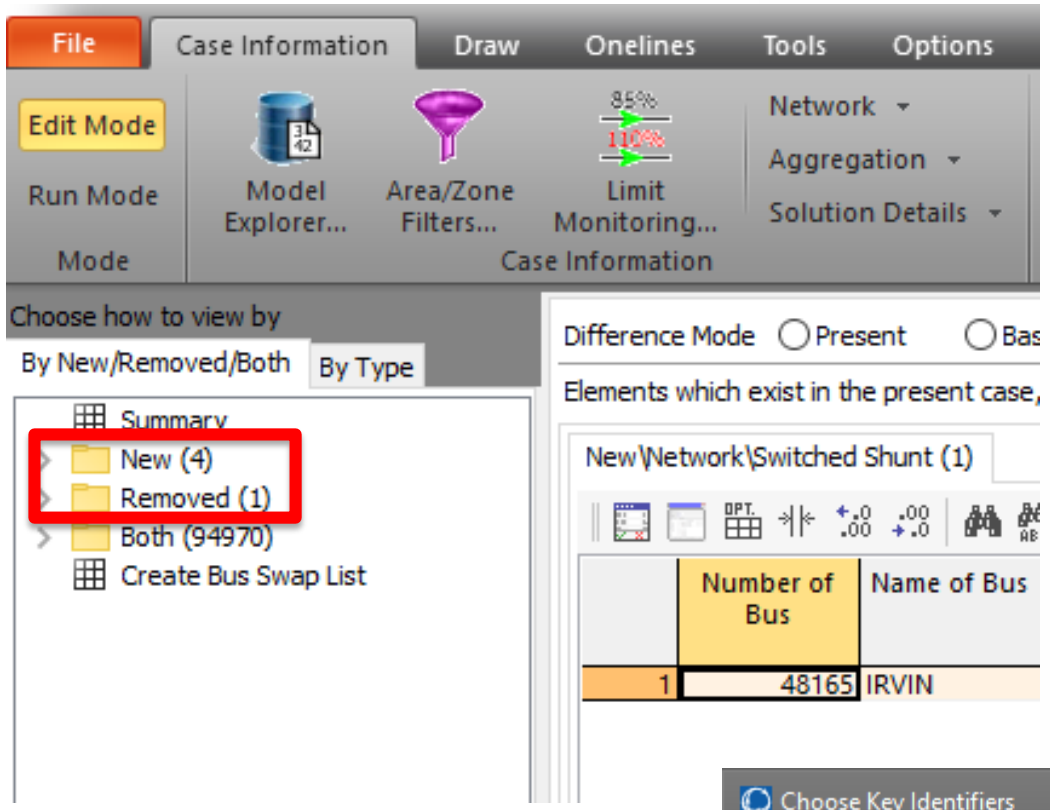
Project Updates Using the Difference Tool

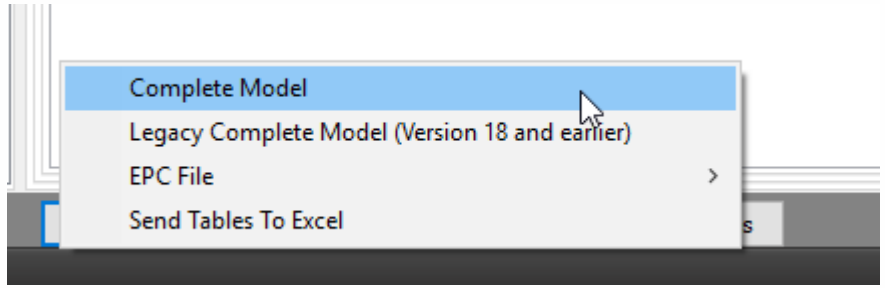


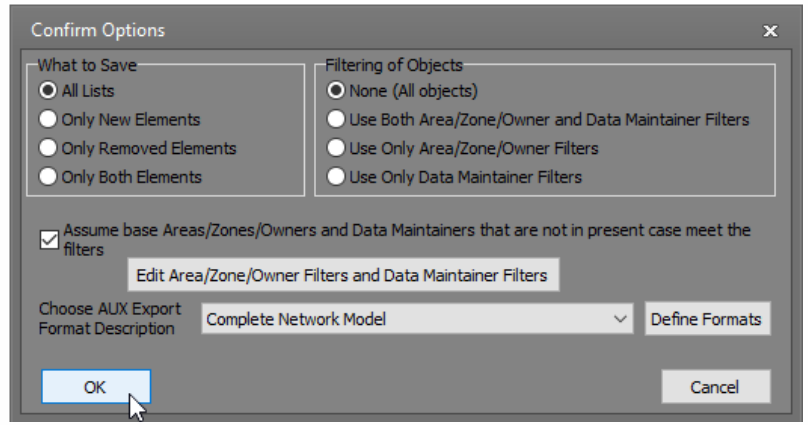
Project Updates Using the Difference Tool

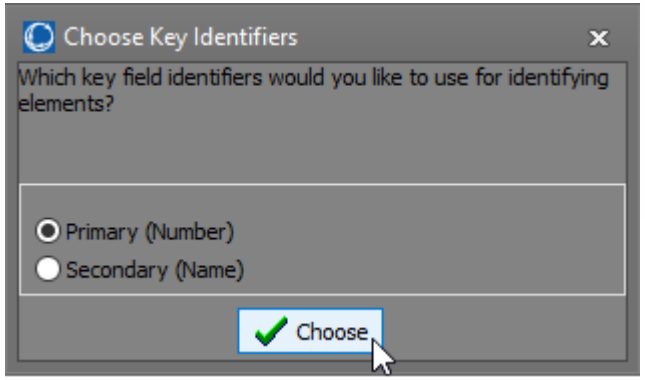


Project Updates Using the Difference Tool







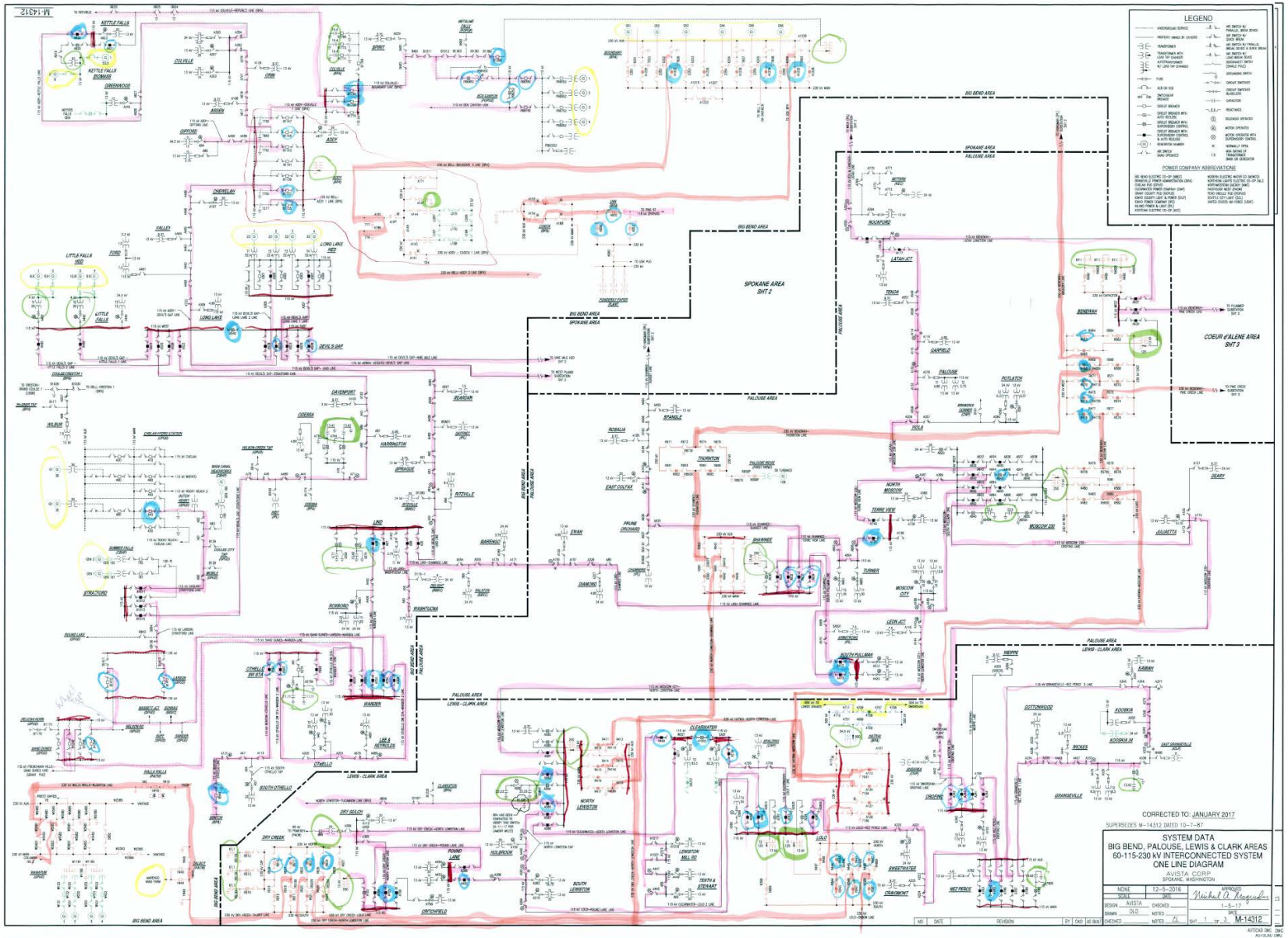


Project Updates Using the Difference Tool

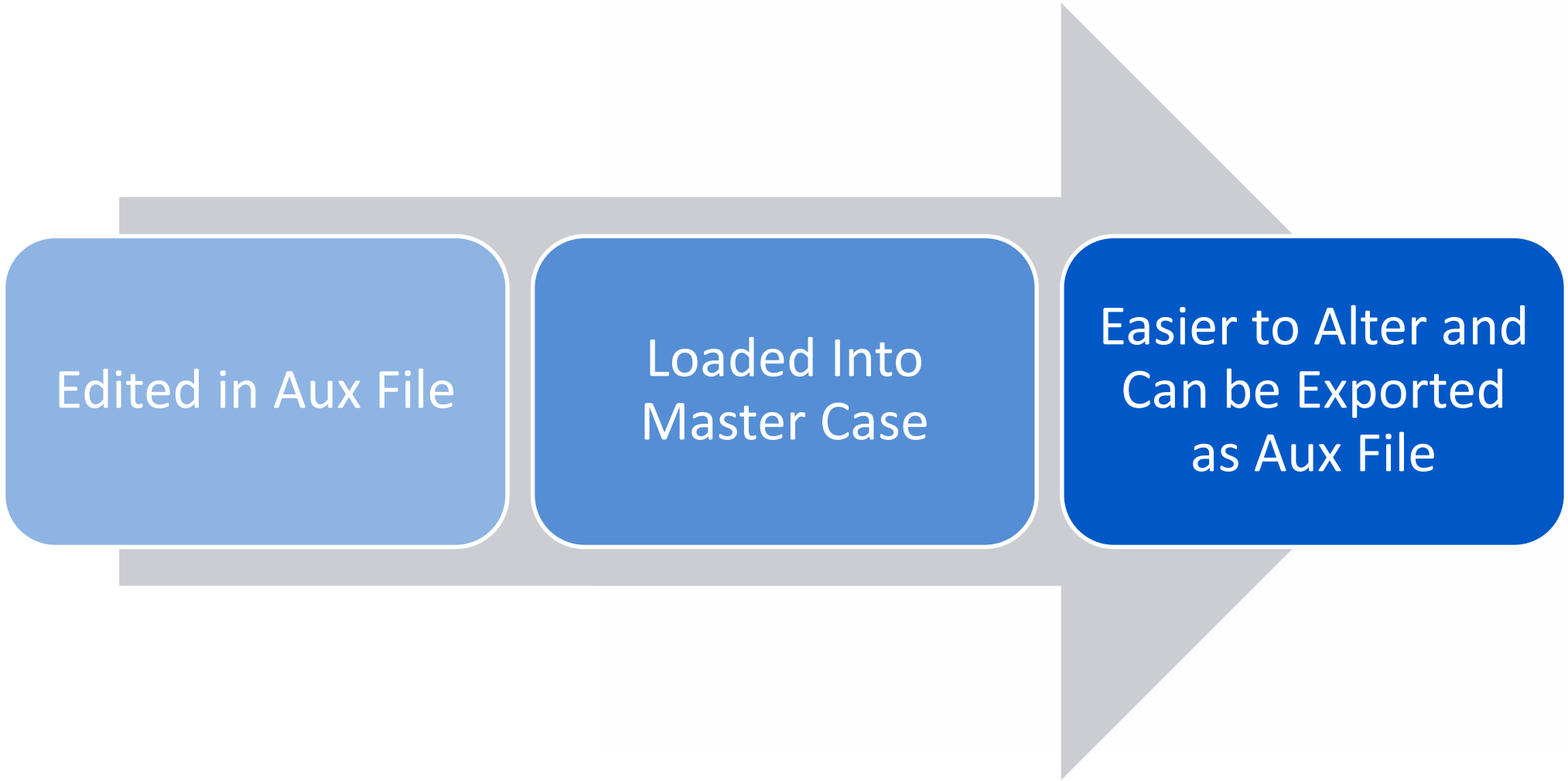
```
//-------------------------------------------------------------
//Benton-Othello 115 rebuild
//  reconductor BentonAVA-SOthello with 795 ACSS "Drake" (105°C)
//  SOthello-OthelloSS Limited by Z3P protection setting (711A)
//-------------------------------------------------------------

//File Revision History
//  Date        Change                          Who
//  2019-1-4    New project file                A. Sylvia



SCRIPT
{
EnterMode(Edit);
}

Branch (BusNum,BusNum:1,LineCircuit,BranchDeviceType,ConsolidateBranch,
   OpenOrCloseBreakersAllow,NormLineStatus,SeriesCapStatus,LineMeter:1,LineR,
   LineX LineC LineG,LineLength,LineMonEle,LSName,LineAMVA,LineAMVA:1,LineAMVA:2,
   LineAMVA:3,LineAMVA:4,LineAMVA:5,LineAMVA:6,LineAMVA:7,LineAMVA:8,LineAMVA:9,
   LineAMVA:10,LineAMVA:11,LineAMVA:12,LineAMVA:13,LineAMVA:14 OwnerNum,
   OwnPercent,OwnerNum:1,OwnPercent:1,OwnerNum:2,OwnPercent:2,OwnerNum:3,
   OwnPercent:3,OwnerNum:4,OwnPercent:4,OwnerNum:5,OwnPercent:5,OwnerNum:6,
   OwnPercent:6,OwnerNum:7,OwnPercent:7,EMSType,EMSDeviceID,EMSDeviceID:1,
   EMSType:1,EMSDeviceID:2,EMSDeviceID:3,DataMaintainerAssign,
   DataMaintainerInherit,AllLabels)
{
 48039  48393 "1"  ""          "" "" ""      ""    ""      0.021900 0.125410 0.018260 "" "" ""    ""  204.6  204.6  262.1  262.1  220.7  220.7  220.7  220.7 "" ""
 48309  48393 "1"  ""          "" "" ""      ""    ""      0.002630 0.015020 0.002200 "" "" ""    ""  141.6  141.6  141.6  141.6  141.6  141.6  141.6  141.6 "" ""
}
```

Changed R, X, B and MVA Limits

Getting Familiar with a Highlighter



SS Contingencies from Stored in Master Case



Steady State Contingency Aux File Updates

```
//------------------------------------------------------------------------
// THE FOLLOWING SECTION CONTAINS THE SS Contingency Changes
//------------------------------------------------------------------------

//REMOVED
CONTINGENCY (CTGLabel,Selected)
{
"BF: A152 Sunset 115 kV, Ninth & Central-Sunset" "YES"
"BF: A198 Sunset 115 kV, Sunset-Westside" "YES"
"BUS: Sunset 115 kV" "YES"
"PSF: Sunset 115 kV" "YES"
"RES: BUS: Sunset 115 kV" "YES"
"S-1: Sunset 115kV Switched Shunt" "YES"
}
SCRIPT
{
Delete(CONTINGENCY,SELECTED);
}

//NEW
Contingency (Name,Category,Skip,RemedialActionInclude,ScreenAllow,Memo,PostCTGAuxFile,
   SolutionOptionsUse,MonitorExceptionsUse,SolutionOptions,DataMaintainerAssign,
   CustomString:RAS,CustomString:Mitigation)
{
"BF: A1125 Airway Heights-Sunset 115 kV, Metro-Sunset 115 kV" "P2" "NO " "YES" "NO " "" "none" "NO " "Use" "" "Avista" "" ""
"BF: A1132 Ninth & Central-Sunset 115 kV, Sunset-Westside 115 kV" "P2" "NO " "YES" "NO " "" "none" "NO " "Use" "" "Avista" "" ""
"S-1: Sunset S1 115kV Switched Shunt" "P1" "NO " "YES" "NO " "" "none" "NO " "Use" "" "Avista" "" ""
"S-1: Sunset S2 115kV Switched Shunt" "P1" "NO " "YES" "NO " "" "none" "NO " "Use" "" "Avista" "" ""
}

ContingencyElement (Contingency,Object,Action,Criteria,TimeDelay,CriteriaStatus,Persistent,Comment)
{
"BF: A1125 Airway Heights-Sunset 115 kV, Metro-Sunset 115 kV" "BRANCH 48225 48421 1" "OPEN" "" 0 "CHECK" "NO " ""
"BF: A1125 Airway Heights-Sunset 115 kV, Metro-Sunset 115 kV" "BRANCH 48009 48421 1" "OPEN" "" 0 "CHECK" "NO " ""

"BF: A1132 Ninth & Central-Sunset 115 kV, Sunset-Westside 115 kV" "BRANCH 48395 48421 1" "OPEN" "" 0 "CHECK" "NO " ""
"BF: A1132 Ninth & Central-Sunset 115 kV, Sunset-Westside 115 kV" "BRANCH 48139 48272 1" "OPEN" "" 0 "CHECK" "NO " ""
"BF: A1132 Ninth & Central-Sunset 115 kV, Sunset-Westside 115 kV" "BRANCH 48131 48421 1" "OPEN" "" 0 "CHECK" "NO " ""
"BF: A1132 Ninth & Central-Sunset 115 kV, Sunset-Westside 115 kV" "BRANCH 48409 48461 1" "OPEN" "" 0 "CHECK" "NO " ""

"S-1: Sunset S1 115kV Switched Shunt" "SHUNT 48421 S1" "OPEN" "" 0 "CHECK" "NO " ""
"S-1: Sunset S2 115kV Switched Shunt" "SHUNT 48421 S2" "OPEN" "" 0 "CHECK" "NO " ""
}
```

Creates a Contingency

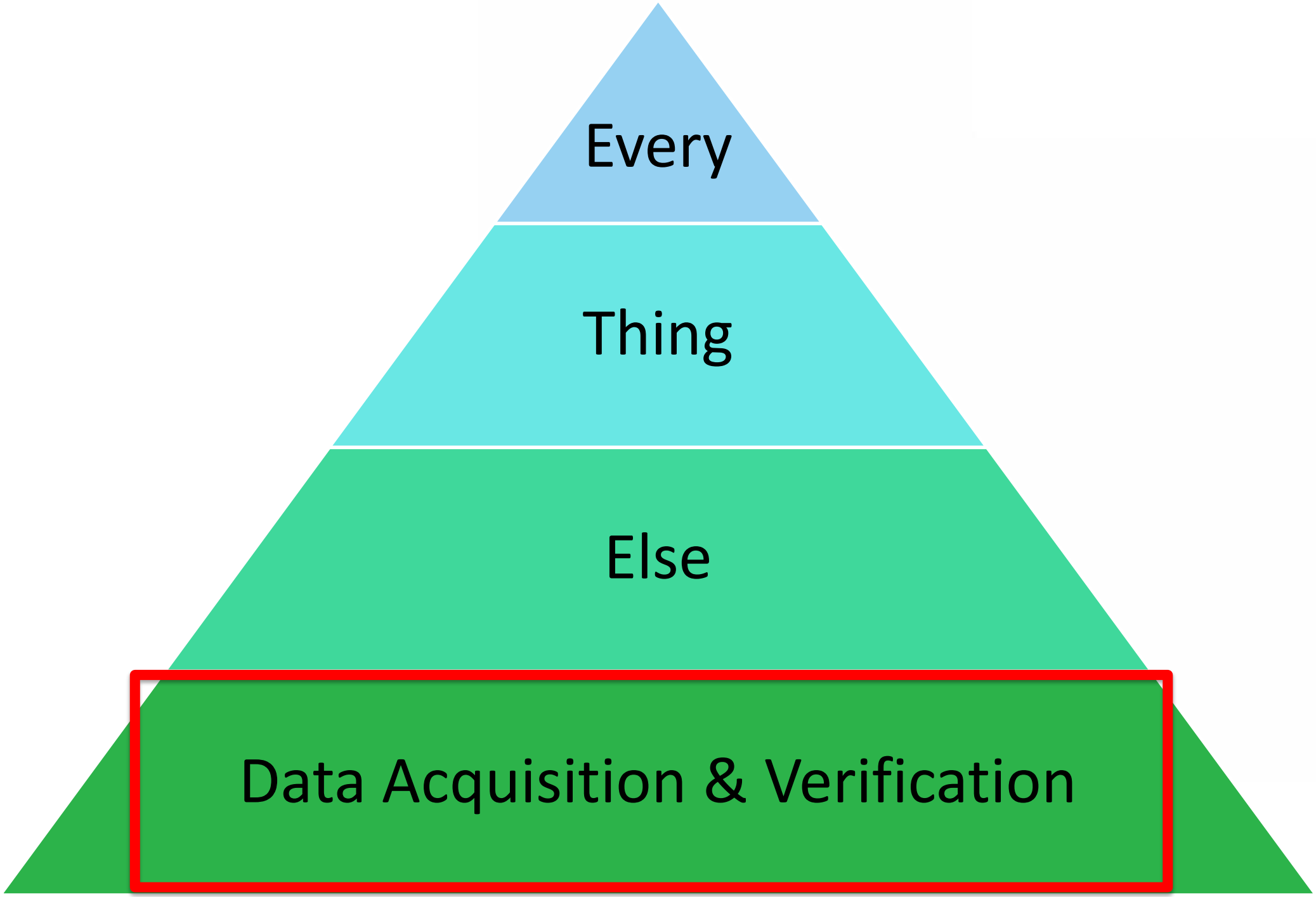
Defines Contingency Actions

Transient Stability Contingency Aux File Updates

```
//NEW TS Contingencies-------------------------------------------------------------
TSContingency (Name,Category,TimeStart,TimeEnd,TimeStepUseCycles,TimeStep,Skip,PlotVisible,
   PlotColor,PlotThickness,PlotDashed,PlotSymbol,DataMaintainerAssign)
{
"BF: A952 Westside 115 kV, Westside 230/115 kV Transformer #1 3P (WES115-WES230 @WES115)" "EES-2"     0.000000    30.000000 "YES"     0.500000 "NO " "YES" -1 Default "Default" "Default" "Avista"   //1
"BF: A952 Westside 115 kV, Westside 230/115 kV Transformer #1 SLG (WES115-WES230 @WES115)" "P4"     0.000000    30.000000 "YES"     0.500000 "NO " "YES" -1 Default "Default" "Default" "Avista"    //2
//-------------------------------------------------------------------------------------------------------------------------------------------------------
"BF: A954 Westside 115 kV, College & Walnut - Westside 115 kV 3P (WES-C&W @WES)" "EES-2"     0.000000    30.000000 "YES"     0.500000 "NO " "YES" -1 Default "Default" "Default" "Avista"          //3
"BF: A954 Westside 115 kV, College & Walnut - Westside 115 kV SLG (WES-C&W @WES)" "P4"     0.000000    30.000000 "YES"     0.500000 "NO " "YES" -1 Default "Default" "Default" "Avista"          //4

}

TSContingencyElement (Contingency,Time,Object,Action,CriteriaStatus,Criteria)
{
"BF: A952 Westside 115 kV, Westside 230/115 kV Transformer #1 3P (WES115-WES230 @WES115)"     1.000000 "BRANCH '48461' '48463' '2'" "FAULT 10 3PB SOLID" "ALWAYS" ""                  //1
"BF: A952 Westside 115 kV, Westside 230/115 kV Transformer #1 3P (WES115-WES230 @WES115)"     1.083000 "BRANCH '48461' '48463' '2'" "OPEN FAR" "ALWAYS" ""
"BF: A952 Westside 115 kV, Westside 230/115 kV Transformer #1 3P (WES115-WES230 @WES115)"     1.217000 "BRANCH '48461' '48463' '2'" "OPEN NEAR" "ALWAYS" ""

"BF: A952 Westside 115 kV, Westside 230/115 kV Transformer #1 SLG (WES115-WES230 @WES115)"     1.000000 "BRANCH '48461' '48463' '2'" "FAULT 10 SLG IMP 0.00485 0.04564" "ALWAYS" ""   //2
"BF: A952 Westside 115 kV, Westside 230/115 kV Transformer #1 SLG (WES115-WES230 @WES115)"     1.083000 "BRANCH '48461' '48463' '2'" "OPEN FAR" "ALWAYS" ""
"BF: A952 Westside 115 kV, Westside 230/115 kV Transformer #1 SLG (WES115-WES230 @WES115)"     1.217000 "BRANCH '48461' '48463' '2'" "OPEN NEAR" "ALWAYS" ""
//-------------------------------------------------------------------------------------------------------------------------------------------------------
"BF: A954 Westside 115 kV, College & Walnut - Westside 115 kV 3P (WES-C&W @WES)"     1.000000 "BRANCH '48461' '48129' '1'" "FAULT 10 3PB SOLID" "ALWAYS" ""                  //3
"BF: A954 Westside 115 kV, College & Walnut - Westside 115 kV 3P (WES-C&W @WES)"     1.083000 "BRANCH '48129' '48081' '1'" "OPEN FAR" "ALWAYS" ""
"BF: A954 Westside 115 kV, College & Walnut - Westside 115 kV 3P (WES-C&W @WES)"     1.217000 "BRANCH '48461' '48129' '1'" "OPEN NEAR" "ALWAYS" ""

"BF: A954 Westside 115 kV, College & Walnut - Westside 115 kV SLG (WES-C&W @WES)"     1.000000 "BRANCH '48461' '48129' '1'" "FAULT 10 SLG IMP 0.00485 0.04564" "ALWAYS" ""   //4
"BF: A954 Westside 115 kV, College & Walnut - Westside 115 kV SLG (WES-C&W @WES)"     1.083000 "BRANCH '48129' '48081' '1'" "OPEN FAR" "ALWAYS" ""
"BF: A954 Westside 115 kV, College & Walnut - Westside 115 kV SLG (WES-C&W @WES)"     1.217000 "BRANCH '48461' '48129' '1'" "OPEN NEAR" "ALWAYS" ""
```

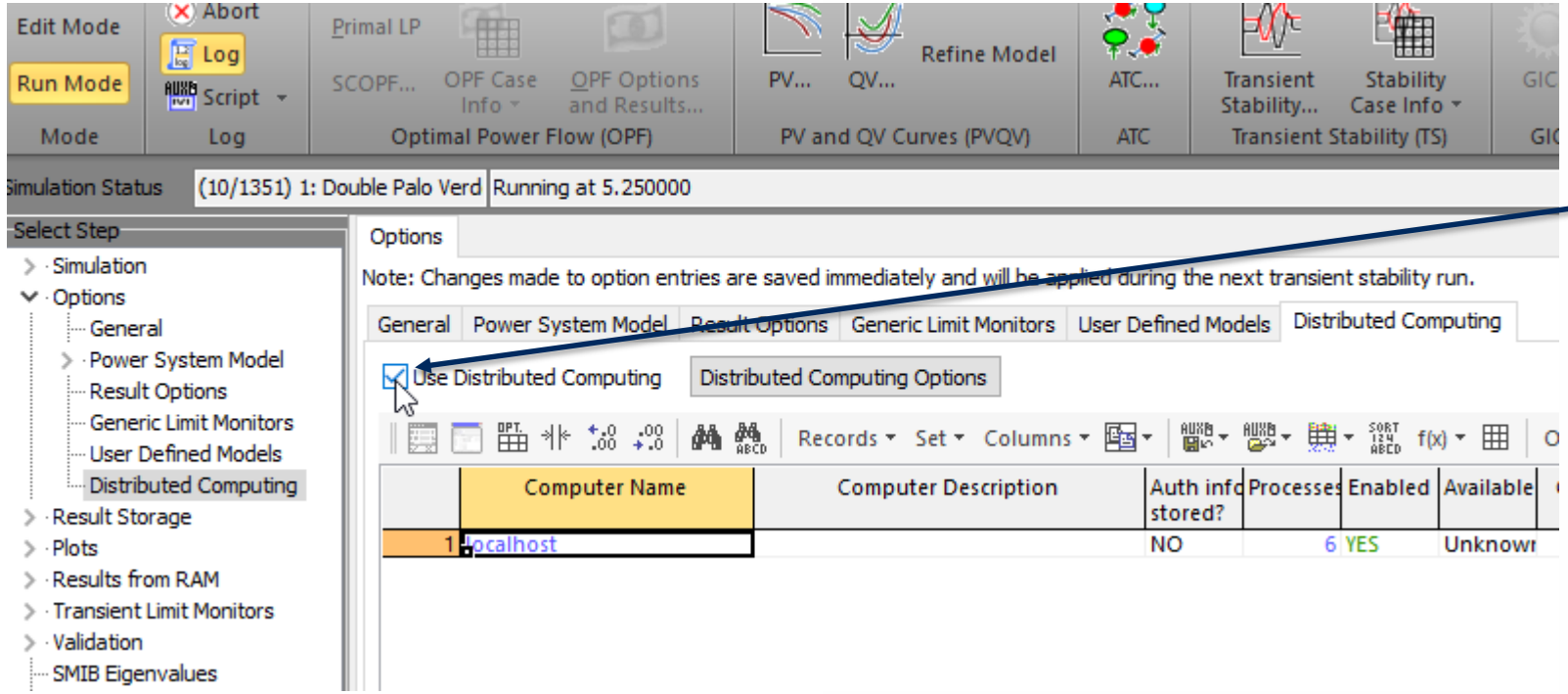
Creates a Contingency

Defines Contingency Actions


Every
Thing
Else
Data Acquisition & Verification

System Planning Team

Final Thought



Make sure it's turned on!

Questions?