Generation Interconnection using PowerWorld Simulator

PowerWorld User's Group

July 2020

PSC at a Glance

150

Subject matter experts

25+

Countries served

19

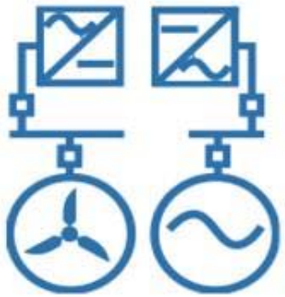
Offices in North America, Europe, & Asia Pacific

24

Years in business

200+ clients

Solution Areas PN



Power Networks

Power system transmission and distribution planning

Power system studies

Generator testing

System operator support

Aerial Laser Survey

Asset management

O&M advisory

Transmission lines

NERC

HVDC

HVDC technology reviews

System and engineering studies

Feasibility and conceptual design

Control and runback systems

Construction cost estimation

EPC spec preparation and FEED

Procurement, construction and commissioning support

Strategic Advisory

Strategies for power networks, systems and operations

Asset strategies

Independent advice, project and business reviews

Electricity market and policy

Me…Education

- Tracy Rolstad
  - Diploma, Naval War College, College of Naval Command and Staff
  - BSEE, University of Idaho
  - Nuclear Navy
    - Nuclear Operational Prototype (S1C)
    - Nuclear Power School (Reactor Operator)
    - Electronics Technician School
      - Radar, Communications, etc.
  - Professional Technical Education
    - Too numerous to list…

Me…Employment

– Power Systems Consultants
  - Technical Director, PSC North America
  - WECC SRS Chair and WECC DS Chair

– Avista Corporation
  - Senior Pwr Sys Consultant, System Planning
  - WECC TSS Chair, Vice Chair, Secretary

– Utility System Efficiencies
  - Senior Power Systems Analyst

– The Bonneville Power Administration
  - Senior Engineer, System Operations

– The Joint Warfare Analysis Center
  - EP Senior Analyst, PACOM Chief of Targets, Special Technical Operations Action Officer

– Nuclear Navy (Attack Submarines)
  - Chief Petty Officer (ETC/SS), Engineering Watch Supervisor

Something novel about me…

06 May 1986

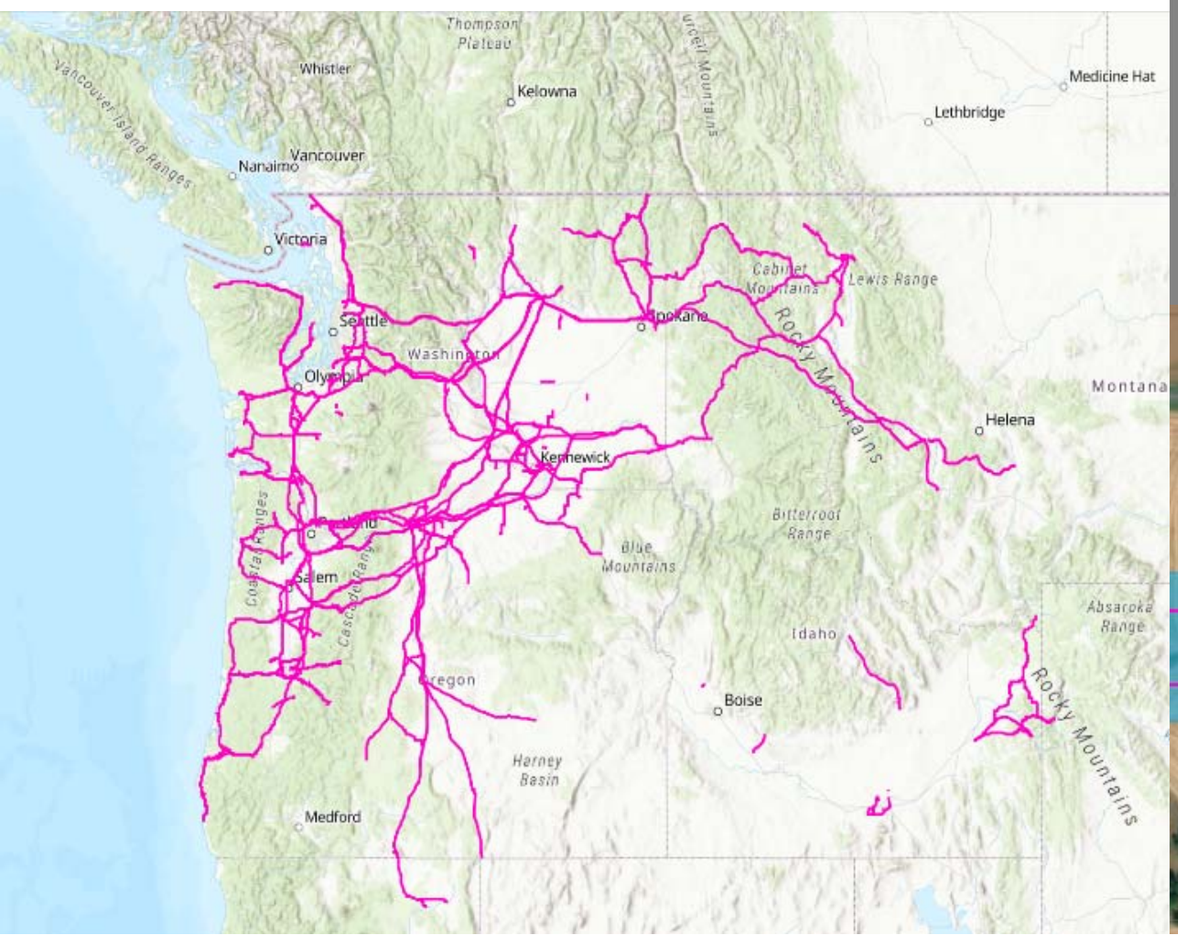
Generation Interconnection

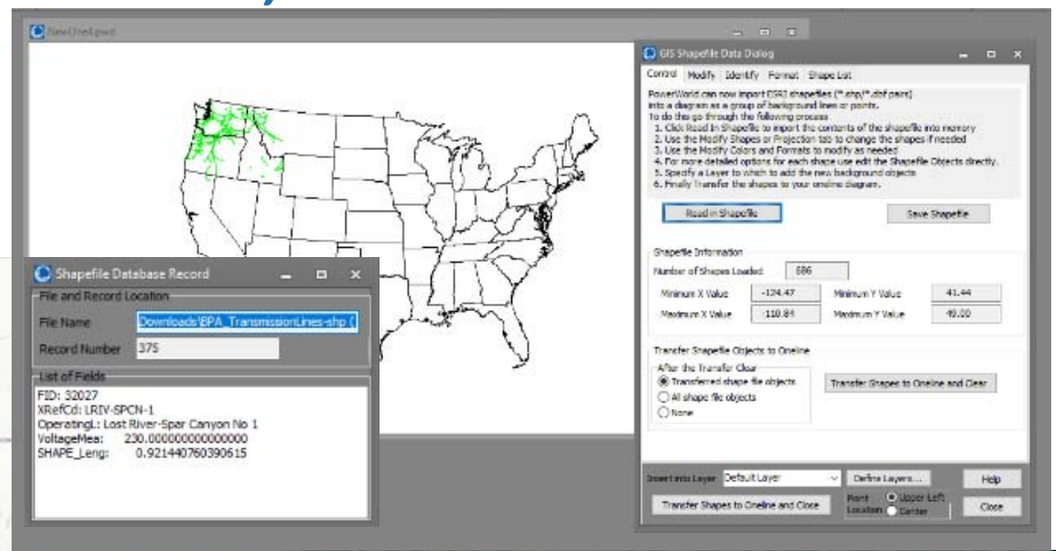
- A generic process
  - Specifically using PWS
    - And other tools as examples
  - Recall that FERC says you MUST allow nondiscriminatory interconnection to your transmission system!
    - You can't say no…try a customer service approach perhaps?!
    - Some people (i.e. transmission owners) still try to make it difficult
    - Which makes no sense since you get paid your tariff rate and your rate-payers will then see rate relief
    - We are not going to discuss the several FERC Orders that mandate this
  - This is really "resource" interconnection since storage is relevant
    - In fact, we will consider resources from a battery perspective

Methods and Tools: A Prospecting Approach

- Where is the Resource?
  - Wind?
    - Very Site Specific. Solar and BESS can really go “anywhere” so we will assume it’s a BESS
- Think Geo-Spatially
  - BPA
    - https://bpagis.maps.arcgis.com/apps/webappviewer/index.html?id=275cd78c003349719b28f7130d4b933e
  - CEC
    - https://cecgis-caenergy.opendata.arcgis.com/datasets/california-electric-substation
  - DHS HIFLD
    - https://hifld-geoplatform.opendata.arcgis.com/datasets/electric-power-transmission-lines
  - LandGrid
  - GoogleEarth

BPA Date: Accurate, Detailed, and Precise



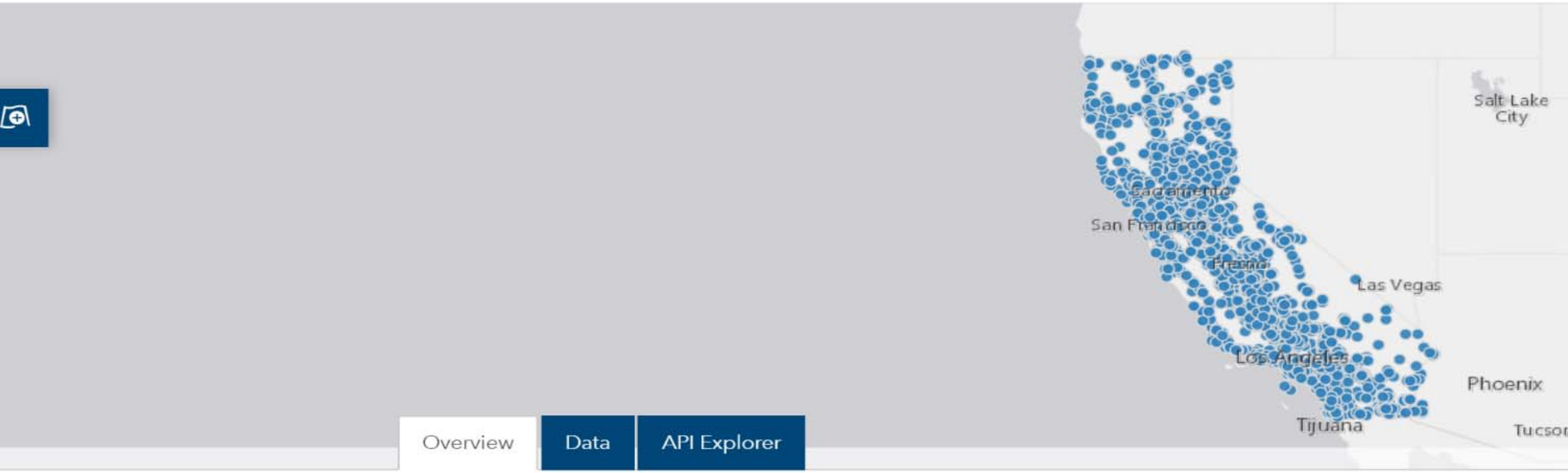


California Energy Commission

CALIFORNIA ENERGY COMMISSION

California Electric Substation

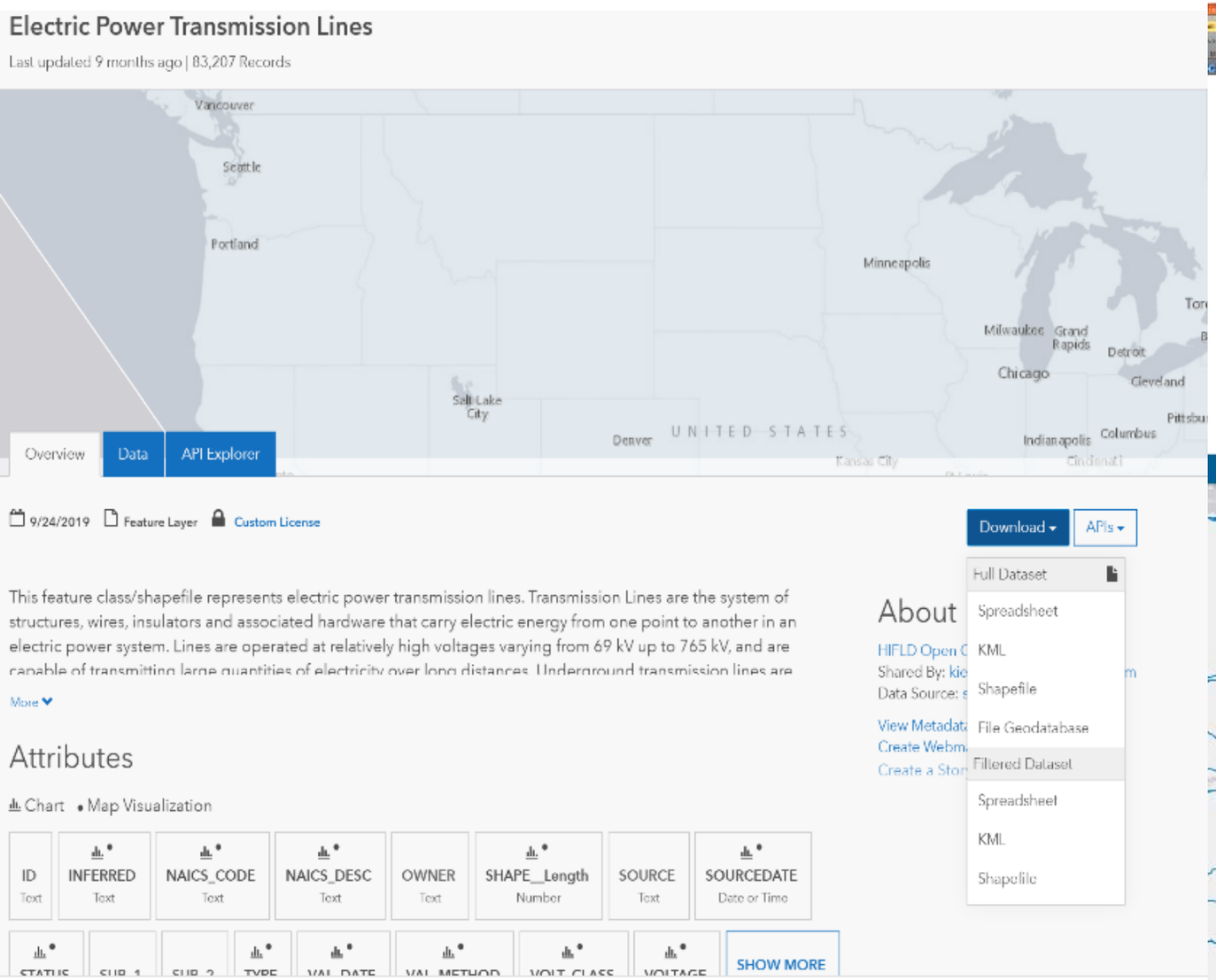
Last updated 5 months ago | 3,255 Records

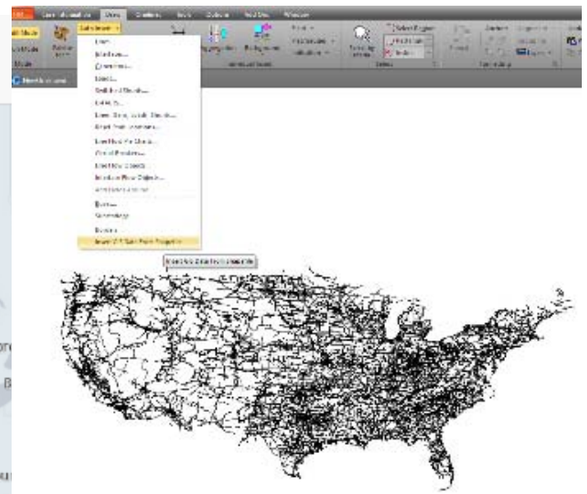


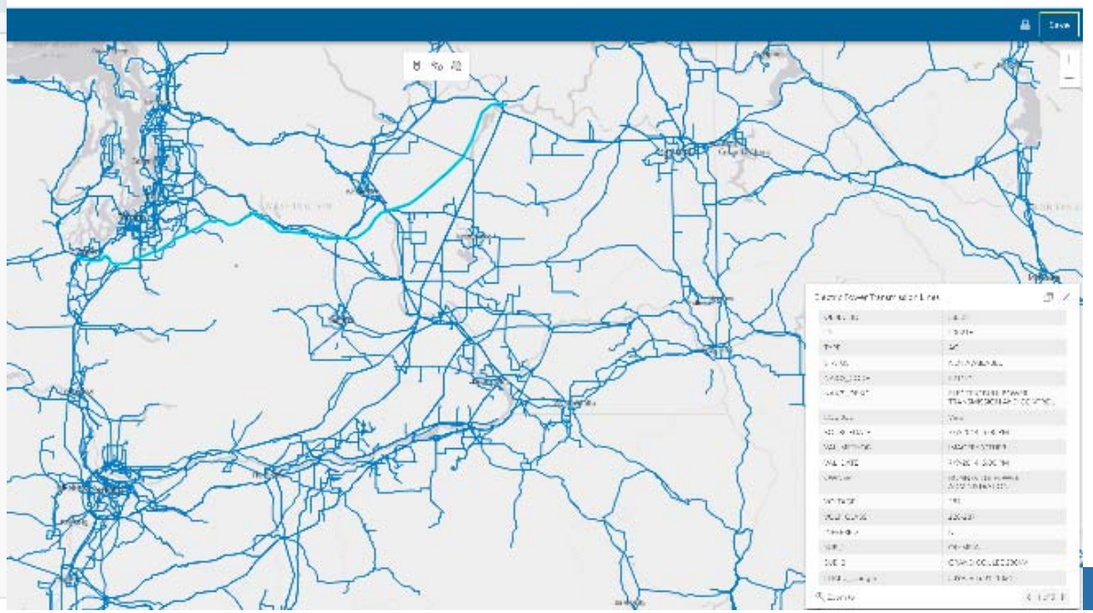
Overview | Data | API Explorer

2/7/2020 | Feature Layer | Custom License

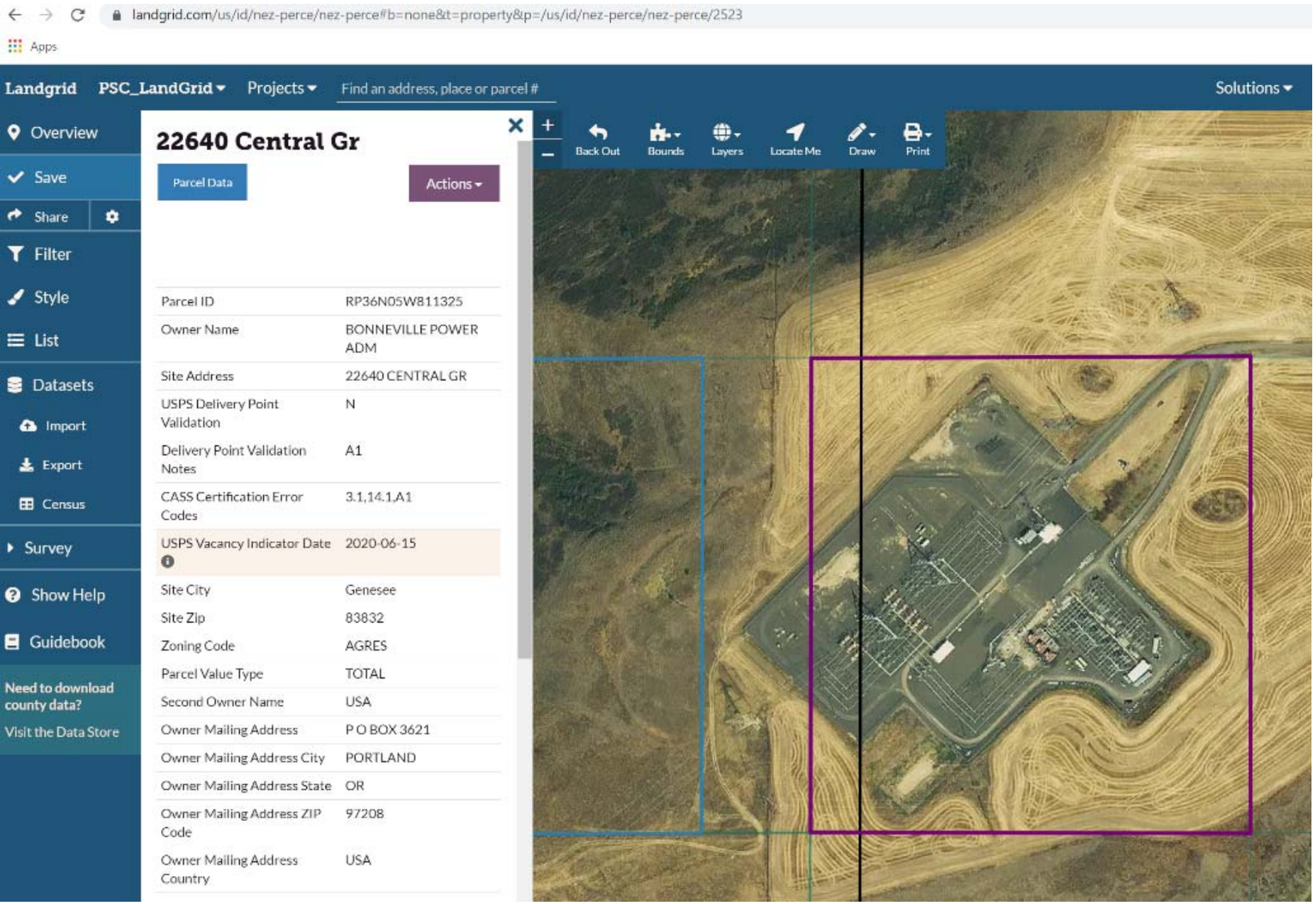
DHS HIFLD: Location is **NOT** a Secret!!!!!







LandGrid



LandGrid and GoogleEarth aid in determining ownership and suitability for development. Imagery analysis can identify spare Positions and station Configuration.

Methods and Tools: Exploiting Base Cases

- Choose your case (one or several)
- Substations
  - Filter by “interconnectedness”
    - Voltage, “tielines”, etc.
- Insert “generators”& build injection groups (and interfaces)
- Create Contingencies
  - Set up P1 through P7 as needed
- Screen with ATC tool
  - After “tuning” the contingencies and the like go to the more complex ATC function
    - Iterated Linear
- Test with Interactive Power Flow
- Consider performing PV analysis with contingencies

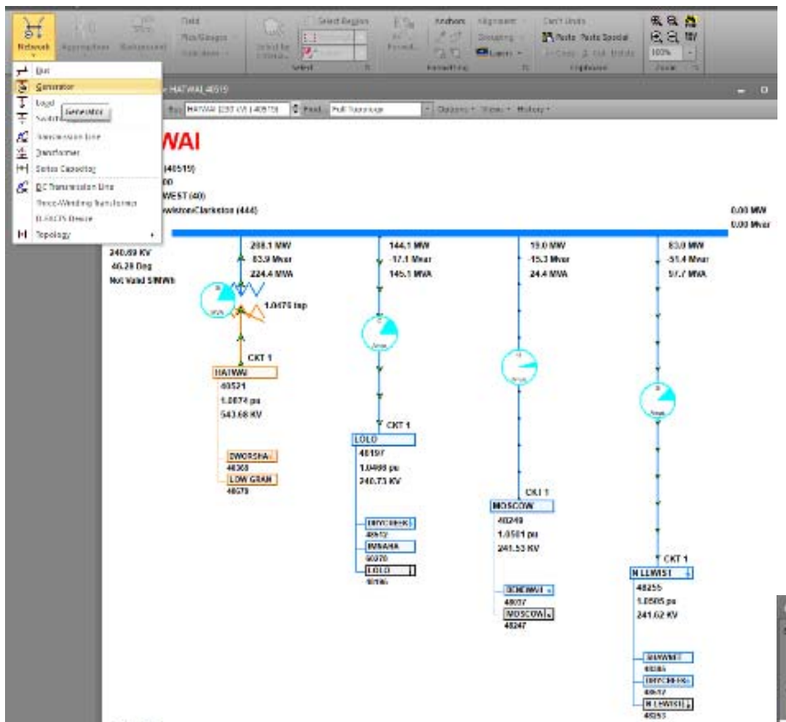
The previous slide is impossible to demonstrate

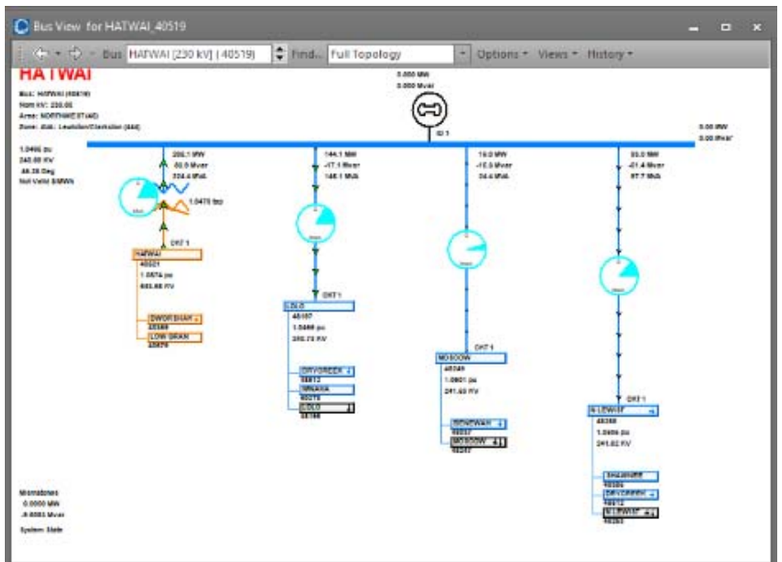
- No way we can demonstrate the previous functions within an hour
  - Literally this is a week long class
    - Covers regulatory environment to how to perform and document technical studies
- Go here please! https://www.powerworld.com/training/online-training
  - Listen to Scott's "radio" voice
  - https://www.powerworld.com/products/simulator/add-ons-2/atc
- We will show slide snippets though

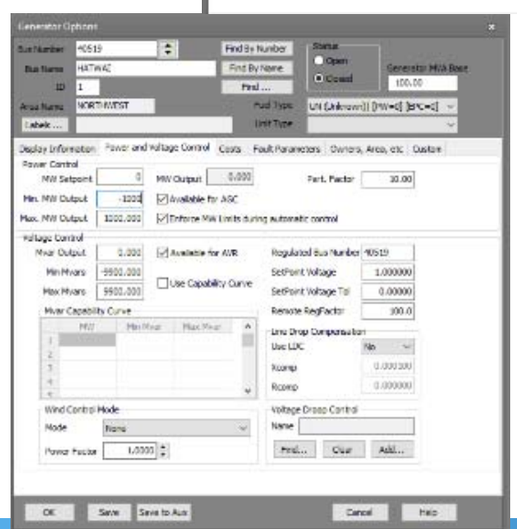
WECC Base Case Selection & Preparation

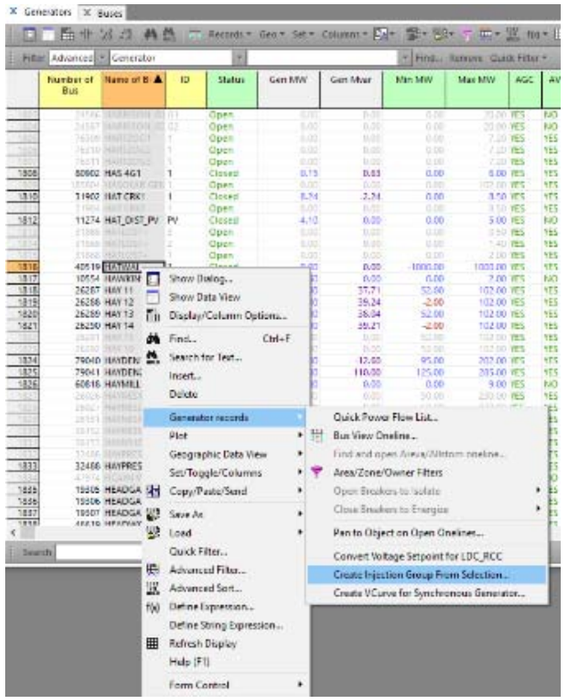
- Join WECC…no charge…sign NDA…get access to base cases
  - Join the System Review Subcommittee and lend a hand!
  - tracyrolstad@pscconsulting.com if you need help joining WECC
- Heavy Summer is often a limiting case
  - Or not…just when IS heavy summer these days?
    - Heavy load is what time? Around 1700? With CAISO solar? Maybe not?
    - Your intuition is probably not relevant anymore
  - Expect to study a number of cases
- Consider fully dispatching designated network resources/firm contract resources
  - This preserves their transmission capacity
  - Recall definition of Network vs Energy Resources

Add Resources, Create injection Groups



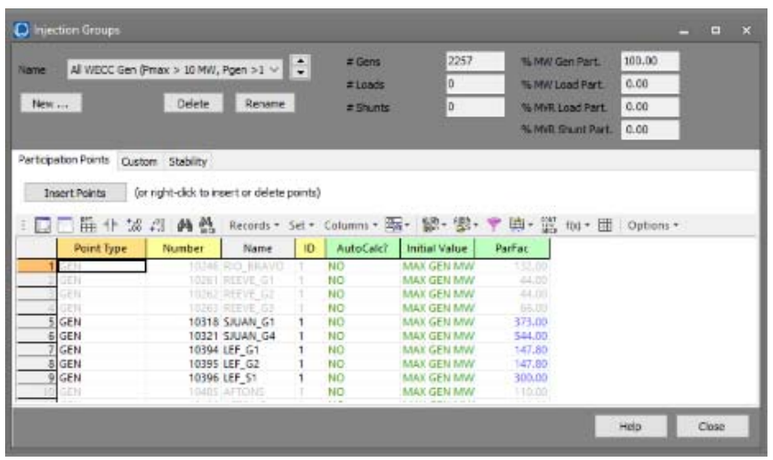






Build an “ALL WECC” Injection Group

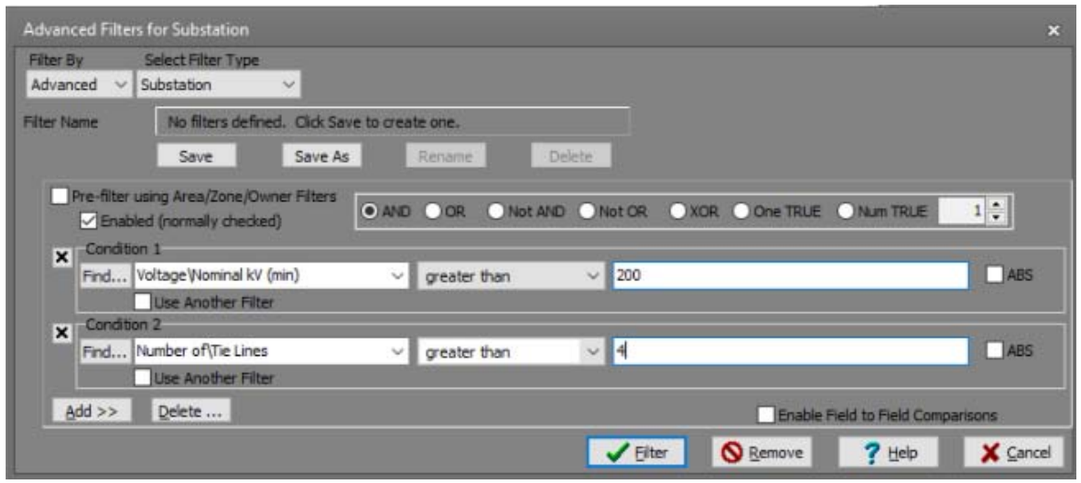
- DO NOT send resource output to slack bus generator
  - Very bad form…
- If a “Network Resource” then sink to designated network resources
  - Consider fully dispatching existing firm contract/designated network resources
  - If proposed resource is too large then go to “ALL WECC” injection group
- Energy Resource should go to all WECC Injection Group
  - Exclude designated network resources from the All WECC injection group

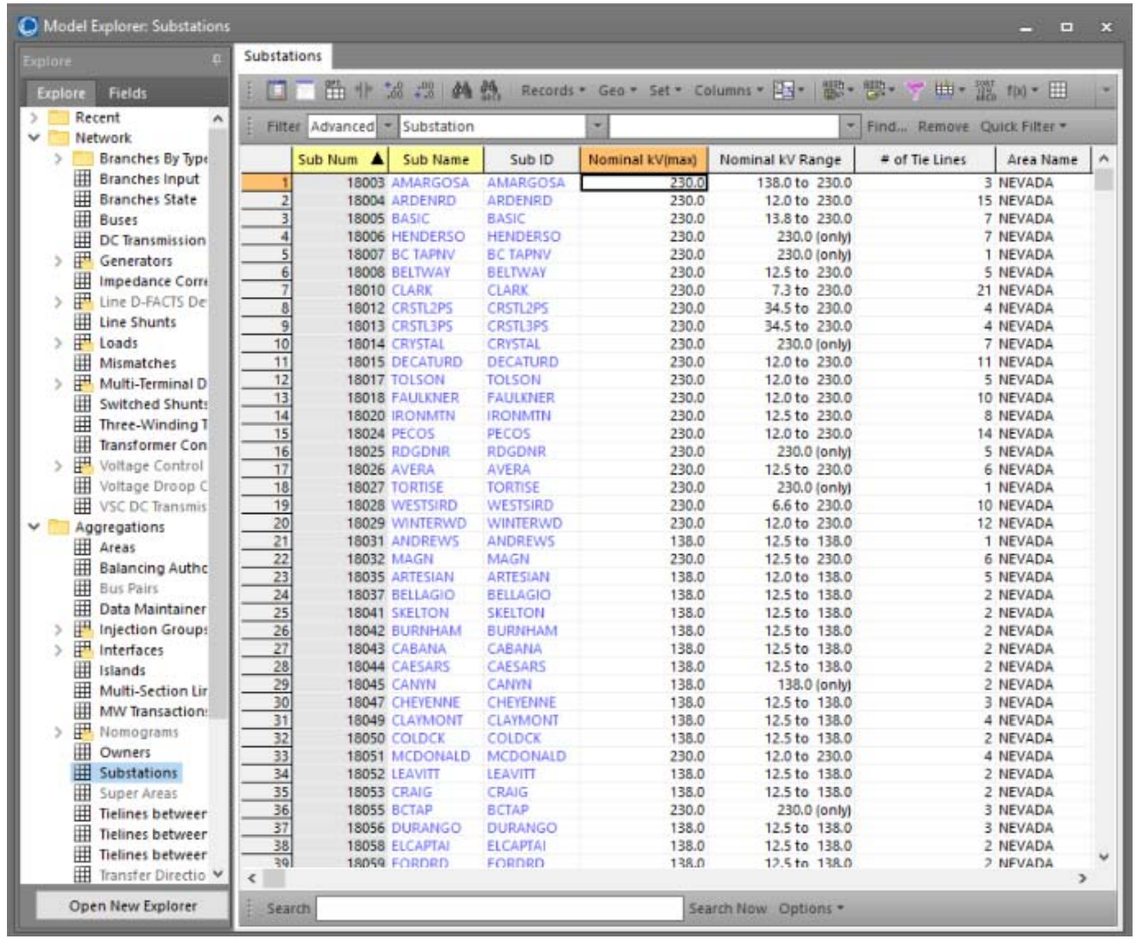


All WECC Gen (Pmax > 10 MW, Pgen >10MW, Pmin=>0)

Create & Filter Substations

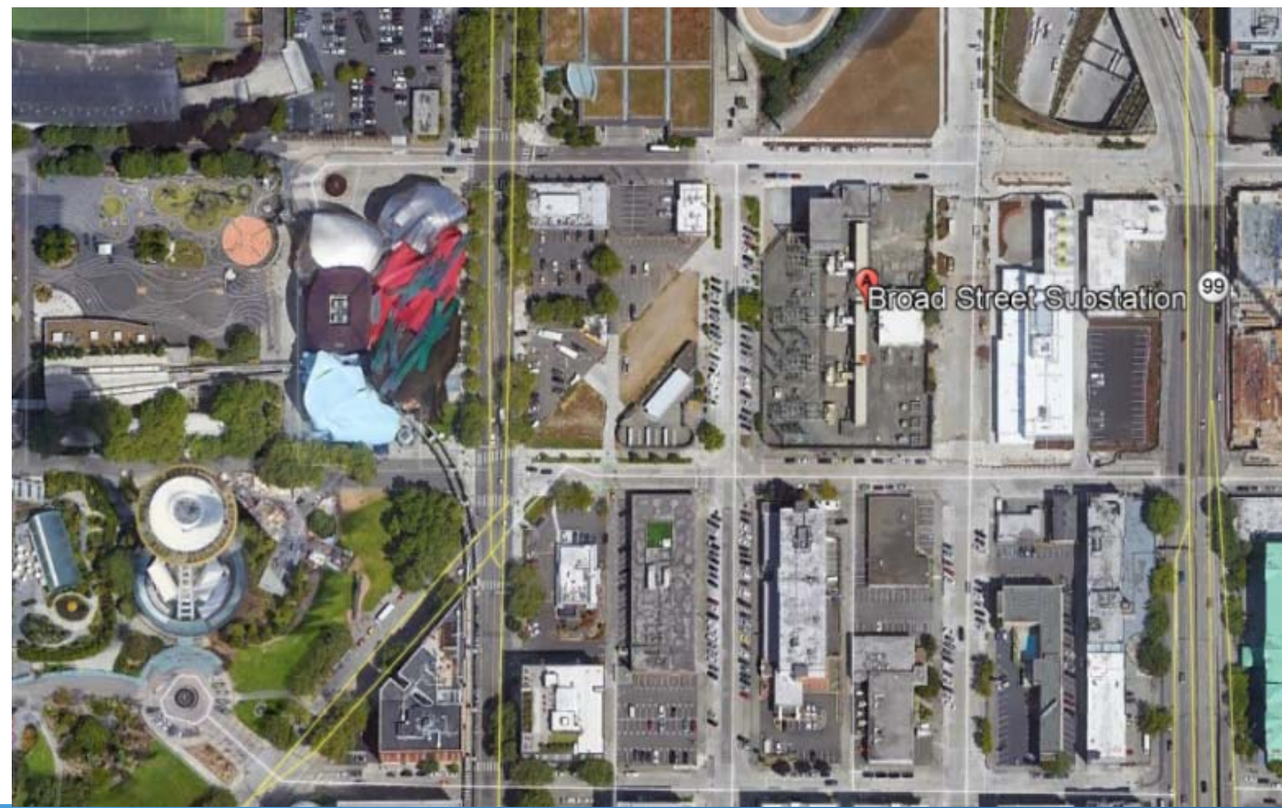
- Look for higher voltages and numerous “tie lines”
  - Right click, display/column options
    - Thanks Caroline for the tie line addition
  - > 200 kV & > 4 tie lines
    - “Good” candidate



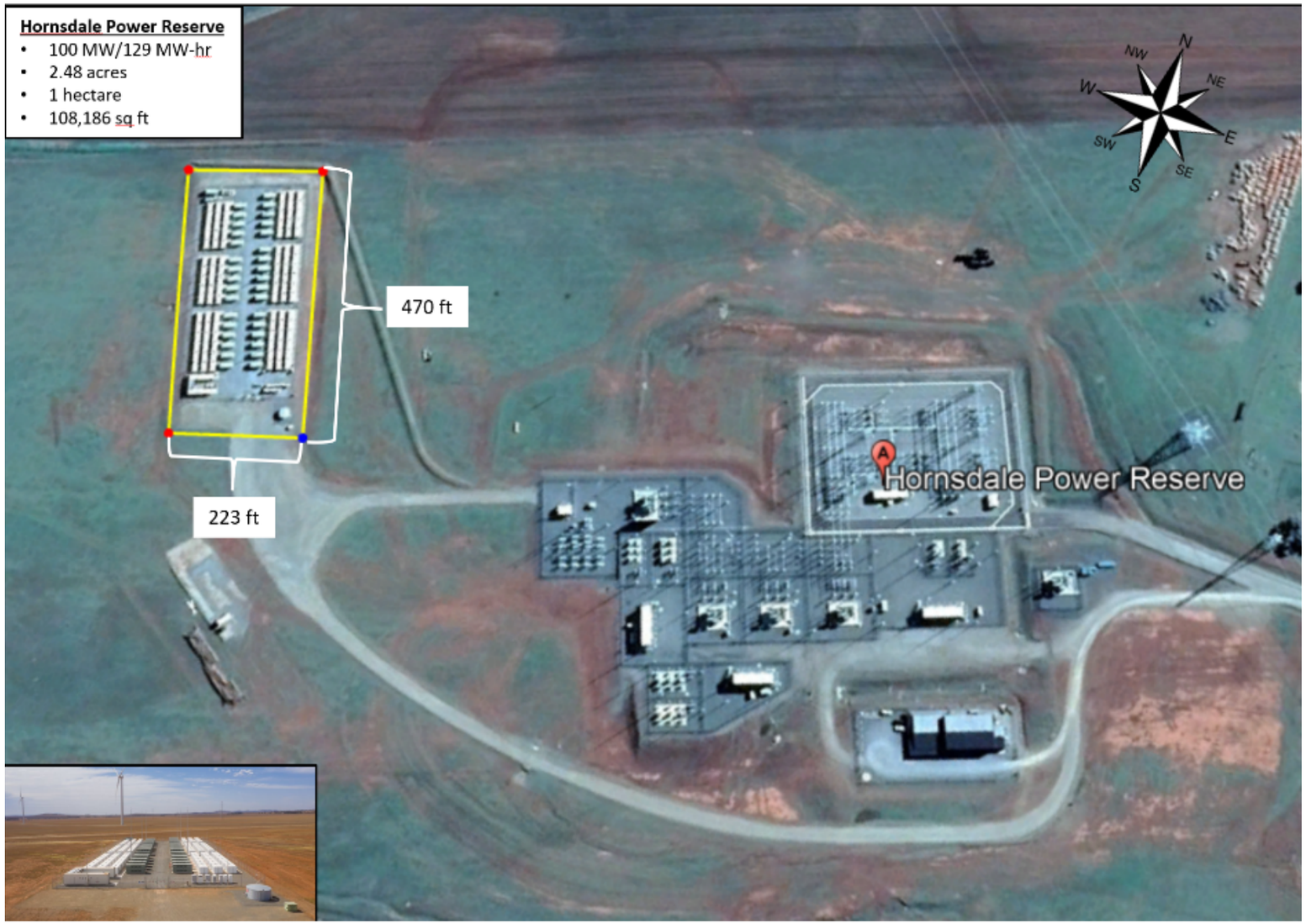


Check Candidate Stations with Imagery

- Viewpoint might be a BESS or solar with station expansion
  - SCL Broadstreet is perhaps not a good choice!
    - Go/no go test
  - Trivia: kml stands for?
    - Keyhole Mark up Language
    - PWS writes KML btw
    - Why is GoogleEarth free?
    - Google didn't write it…gov't software

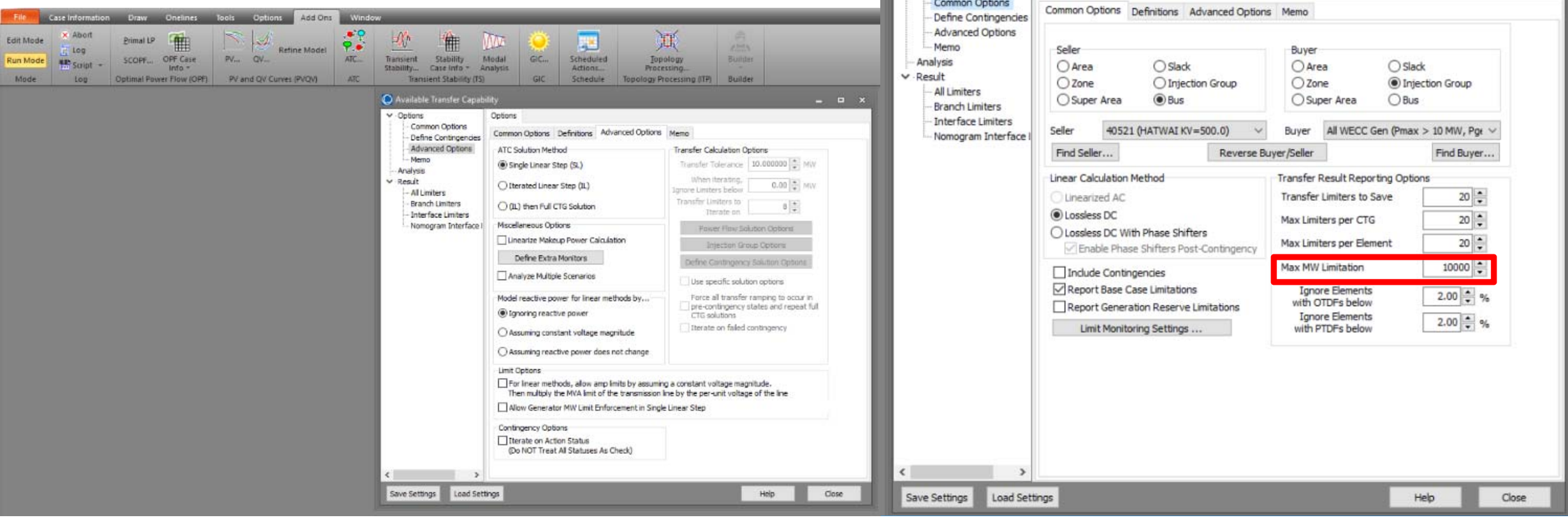


Example BESS (Tesla, presently worlds largest)

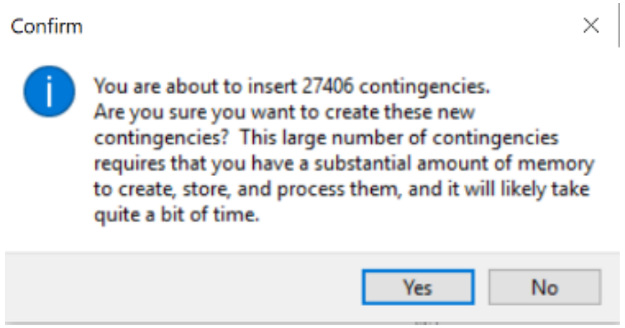


Use ATC to Facilitate Transfer from Resource

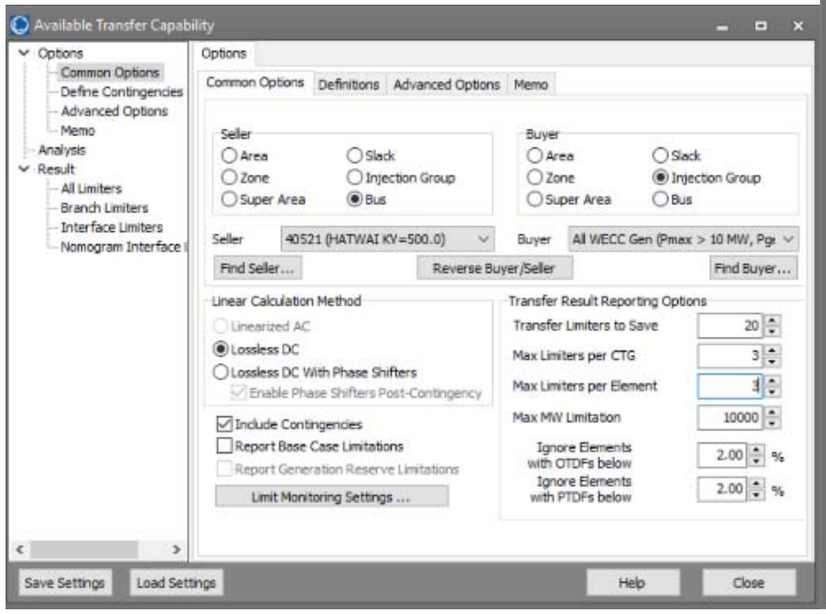
- Hatwai to All WECC
  - Choose Single Linear first…fast…you learn how to ignore or “tune” limiters and ctgs
    - Ignore ctgs first

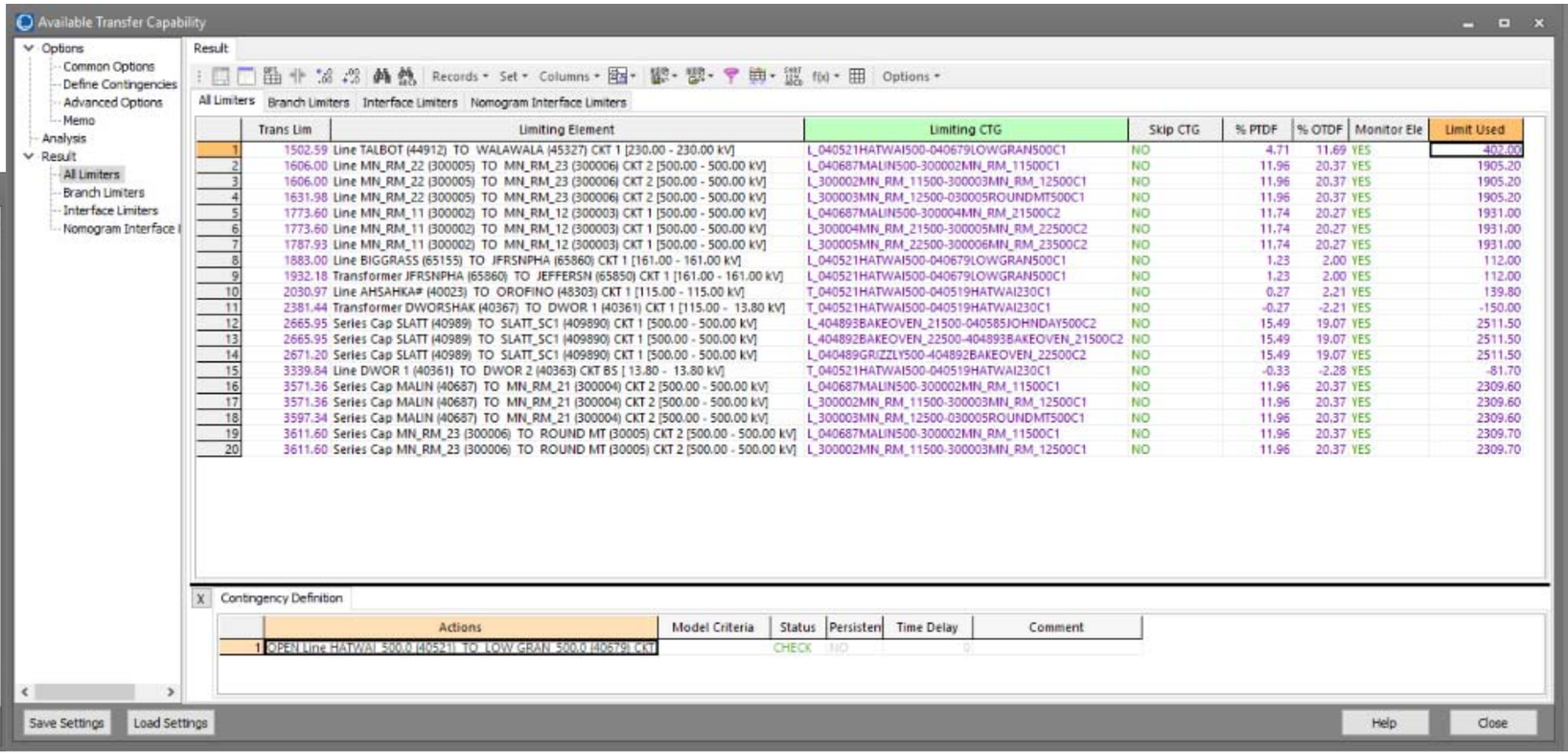


Run Contingencies, Stay Single Linear, Think

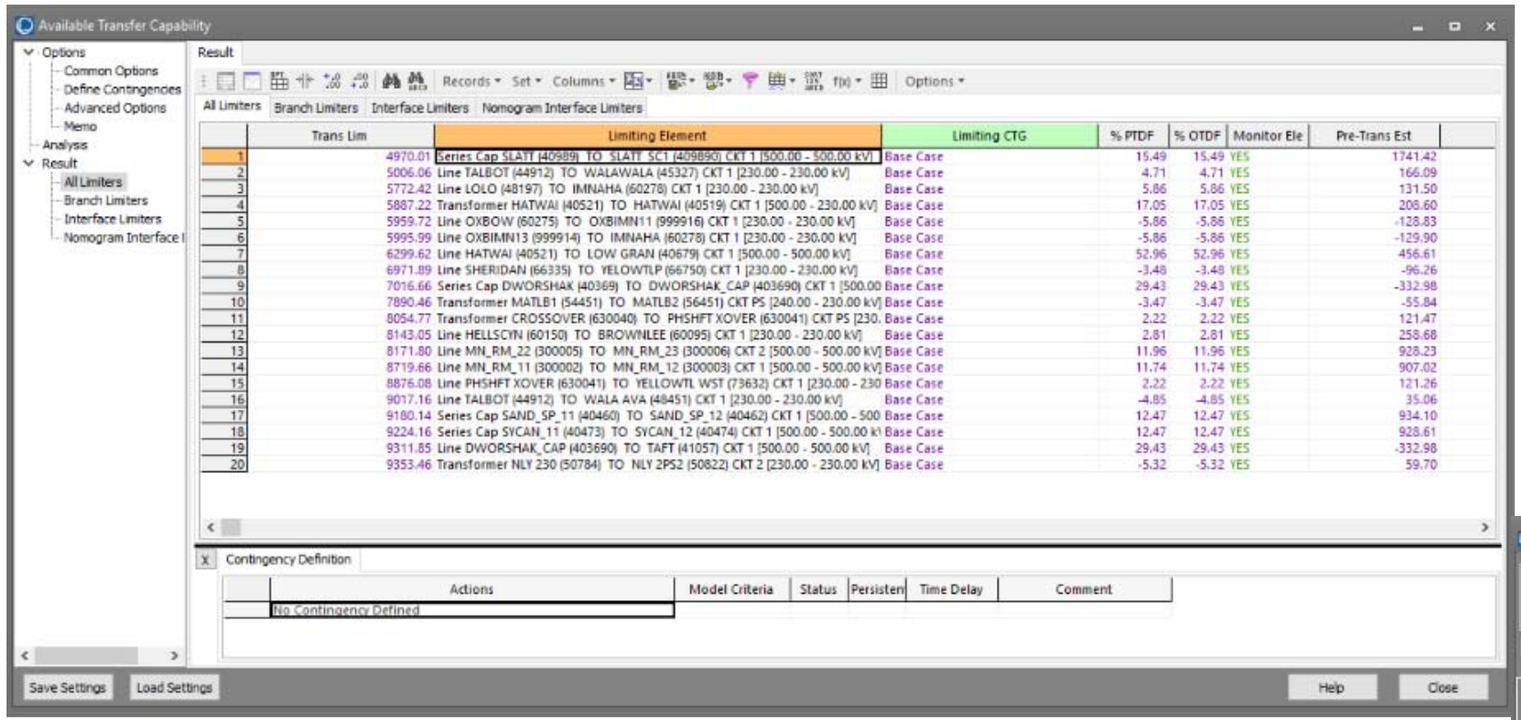


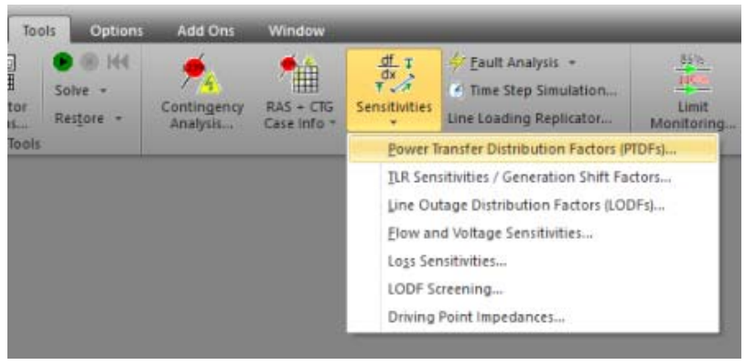
500 kV stations can accommodate large amounts of generation.



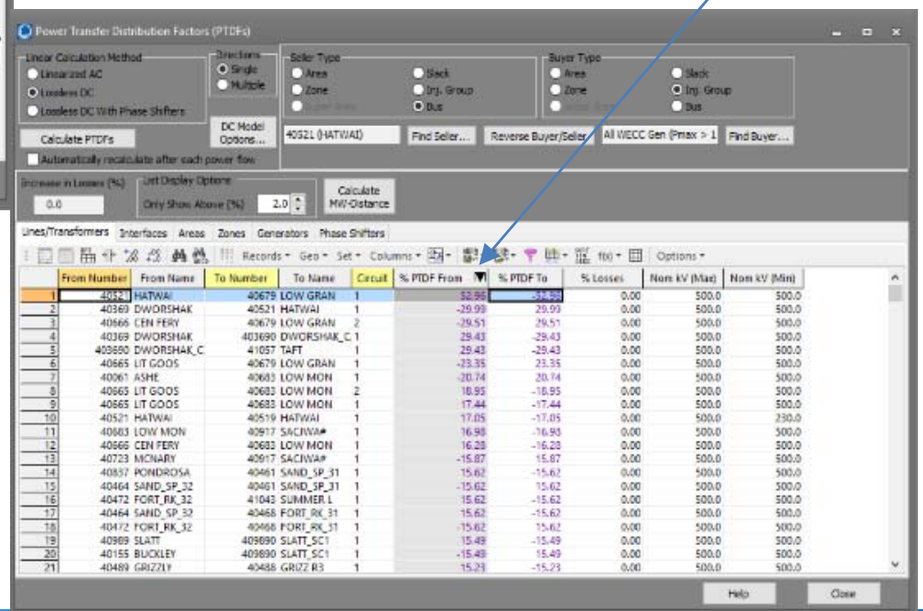


Results: ATC Tool…then examine PTDF Sensitivity

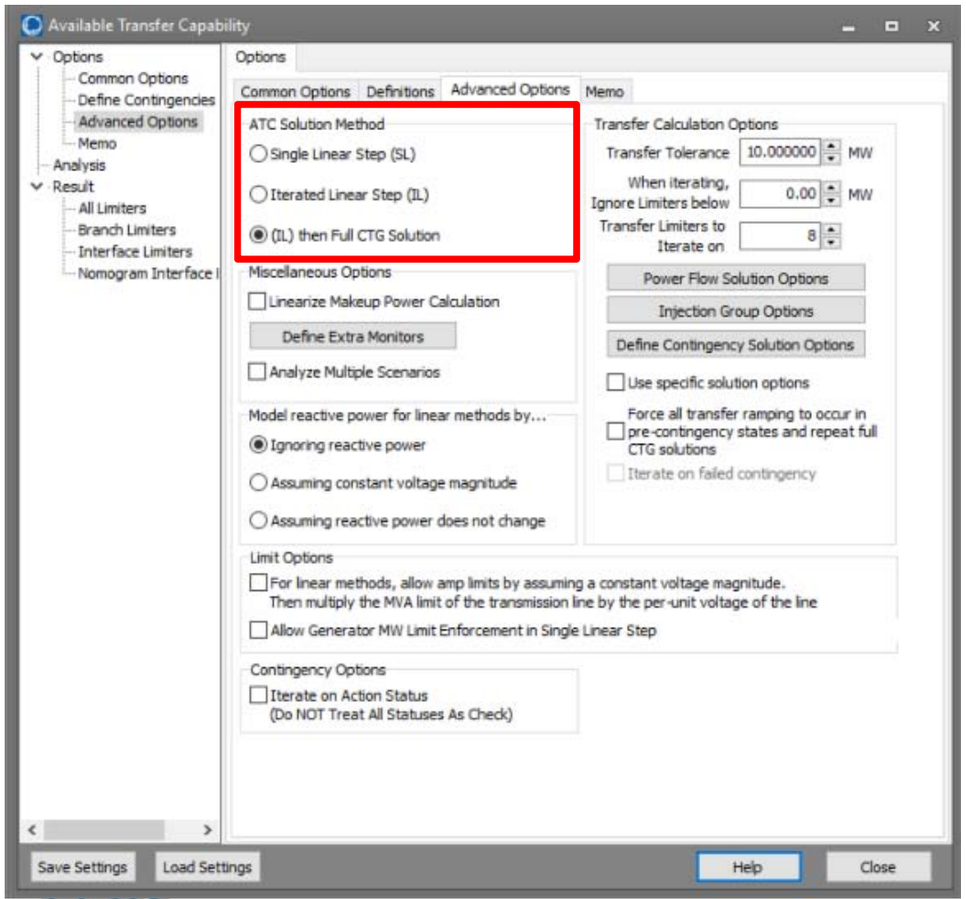




Shift, Up Arrow gets ABS Sort



ATC Methods…Fast to Slow…Accuracy Improves



This method takes the solution process a step further than just the Iterated Linear (IL) method. Instead of using linear sensitivities to calculate the impact of contingencies on the transfer limits, full contingencies are implemented and solved with a full power flow solution. Be aware however, that this calculation method can be extremely slow.

Finish with Interactive PF and PV Tool

- This is a subject for another presentation…
  - PV tool can track ctg overloads AND poor voltage performance
    - Tells developers what the approximate maximum is

Questions?

- tracy.rolstad@pscconsulting.com
- Generation Interconnection part 2 will be cover use of PV tool
  - This subject is a three day course.
    - This can be provided if folks are interested.

Thank You!