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**Yellow = utility API,**

**Green = user API,**

**Purple = simulation dashboard API**

API 1: get grid details  
API 2: add generator  
API 4: modify load household  
API 5: add device  
API 6: create dfp  
API 7: subscribe dfp  
API 8: modify dfp  
API 9: execute dfp  
API 10: unsubscribe dfp  
API 11: delete dfp  
API 12: modify load device  
API 13: disconnect device  
API 14: add storage  
API 15: toggle storage  
API 16: upload zip file  
API 17: switch test system  
API 18: add new household  
API 19: save cache  
API 20: load cache  
API 21: modify household  
API 22: delete household  
API 23: get dfp details  
API 24: send dfp to neighborhood

## APIs Description:

### API 1: get grid details

#### Parameters:

None

#### Description:

This API simulates a "system refresh" or a request for the most current state of the entire power grid. When called, it runs a full power flow simulation, automatically manages any transformer overloads, and then returns a complete snapshot of the system. This includes the overall power summary, voltage profiles across the network, and a detailed list of every node with its connected transformers, devices, and DFP subscriptions.

#### Response:

```
{
  "results": {
    "bus_details": [
      {
        "Bus": "150",
        "Coordinates": {
          "X": 100.0,
          "Y": 1500.0
        },
        "DFPs": [],
        "Devices": [],
        "Gen_kW": 0,
        "Load_kW": 0.0,
        "Net_Power_kW": 0.0,
        "StorageDevices": [],
        "Transformers": [],
        "VAngle": -0.002389991365347438,
        "VMag_pu": 0.9999709194847864
      },
      {
        "Bus": "149",
        "Coordinates": {
          "X": 300.0,
          "Y": 1500.0
        },
        "DFPs": [],
        "Devices": [],
```

```

    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -0.010456161114586787,
    "VMag_pu": 0.9992527881808037
  },
  {
    "Bus": "1",
    "Coordinates": {
      "X": 700.0,
      "Y": 1500.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [
      {
        "current_kVA": 195.33,
        "loading_percent": 65.11,
        "name": "xfmr_neigh_1",
        "rated_kVA": 300.0,
        "status": "OK"
      }
    ],
    "VAngle": -1.430968197646482,
    "VMag_pu": 0.9594130742907941
  },
  {
    "Bus": "7",
    "Coordinates": {
      "X": 1000.0,
      "Y": 1500.0
    },
    "DFPs": [],
    "Devices": [],

```

```
"Gen_kW": 0,
"Load_kW": 20.0,
"Net_Power_kW": -20.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -2.4836181101588806,
"VMag_pu": 0.9317593364418078
},
{
  "Bus": "8",
  "Coordinates": {
    "X": 1200.0,
    "Y": 1500.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [
    {
      "current_kVA": 116.95,
      "loading_percent": 38.98,
      "name": "xfmr_neigh_2",
      "rated_kVA": 300.0,
      "status": "OK"
    }
  ],
  "VAngle": -3.220628934208017,
  "VMag_pu": 0.9135070217234847
},
{
  "Bus": "13",
  "Coordinates": {
    "X": 1500.0,
    "Y": 1500.0
  },
  "DFPs": [],
  "Devices": [],
```

```
"Gen_kW": 0,
"Load_kW": 0.0,
"Net_Power_kW": 0.0,
"StorageDevices": [],
"Transformers": [
  {
    "current_kVA": 166.93,
    "loading_percent": 55.64,
    "name": "xfmr_neigh_3",
    "rated_kVA": 300.0,
    "status": "OK"
  }
],
"VAngle": -4.321066277844254,
"VMag_pu": 0.8875531342639326
},
{
  "Bus": "152",
  "Coordinates": {
    "X": 1600.0,
    "Y": 1500.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -4.327293659844598,
  "VMag_pu": 0.8871808681706731
},
{
  "Bus": "52",
  "Coordinates": {
    "X": 2000.0,
    "Y": 1500.0
  },
  "DFPs": [],
  "Devices": [],
```

```

    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -5.273373749467952,
    "VMag_pu": 0.8659741713584911
  },
  {
    "Bus": "53",
    "Coordinates": {
      "X": 2200.0,
      "Y": 1500.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -5.763936286130592,
    "VMag_pu": 0.8554626417952576
  },
  {
    "Bus": "54",
    "Coordinates": {
      "X": 2325.0,
      "Y": 1500.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [
      {
        "current_kVA": 67.55,
        "loading_percent": 22.52,

```

```

        "name": "xfmr_neigh_4",
        "rated_kVA": 300.0,
        "status": "OK"
    }
],
"VAngle": -6.0766929218334615,
"VMag_pu": 0.8489254184969102
},
{
    "Bus": "94_open",
    "Coordinates": {
        "X": 0.0,
        "Y": 0.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -6.0766929218334615,
    "VMag_pu": 0.8489254184969102
},
{
    "Bus": "57",
    "Coordinates": {
        "X": 2325.0,
        "Y": 1850.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -6.884359396309772,
    "VMag_pu": 0.8317327780290756
},

```



```
{
  "Bus": "60",
  "Coordinates": {
    "X": 3075.0,
    "Y": 1850.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [
    {
      "current_kVA": 278.68,
      "loading_percent": 92.89,
      "name": "xfmr_neigh_9",
      "rated_kVA": 300.0,
      "status": "Critical"
    }
  ],
  "VAngle": -8.731596423130965,
  "VMag_pu": 0.7954855077494127
},
{
  "Bus": "160",
  "Coordinates": {
    "X": 3175.0,
    "Y": 1850.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -8.738838673569134,
  "VMag_pu": 0.7952241337663687
},
```

```

{
  "Bus": "160r",
  "Coordinates": {
    "X": 3175.0,
    "Y": 1850.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -8.742598335669497,
  "VMag_pu": 0.7952008869612661
},
{
  "Bus": "67",
  "Coordinates": {
    "X": 3525.0,
    "Y": 1850.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [
    {
      "current_kVA": 170.09,
      "loading_percent": 56.7,
      "name": "xfmr_neigh_12",
      "rated_kVA": 300.0,
      "status": "OK"
    }
  ],
  "VAngle": -9.473713198840036,
  "VMag_pu": 0.7822928254320309
},

```

```

{
  "Bus": "97",
  "Coordinates": {
    "X": 3525.0,
    "Y": 2100.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -9.640735074716511,
  "VMag_pu": 0.7793058975421726
},
{
  "Bus": "197",
  "Coordinates": {
    "X": 3525.0,
    "Y": 2200.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -9.642671832989404,
  "VMag_pu": 0.7792129296215656
},
{
  "Bus": "101",
  "Coordinates": {
    "X": 3525.0,
    "Y": 2450.0
  },
  "DFPs": [],
  "Devices": [],

```

```
"Gen_kW": 0,
"Load_kW": 0.0,
"Net_Power_kW": 0.0,
"StorageDevices": [],
"Transformers": [
  {
    "current_kVA": 153.62,
    "loading_percent": 51.21,
    "name": "xfmr_neigh_13",
    "rated_kVA": 300.0,
    "status": "OK"
  }
],
"VAngle": -9.81100259611622,
"VMag_pu": 0.7762326948652664
},
{
  "Bus": "105",
  "Coordinates": {
    "X": 3525.0,
    "Y": 2725.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -9.903544168734372,
  "VMag_pu": 0.7746012222957545
},
{
  "Bus": "108",
  "Coordinates": {
    "X": 3525.0,
    "Y": 3050.0
  },
  "DFPs": [],
  "Devices": [],
```

```
"Gen_kW": 0,
"Load_kW": 0.0,
"Net_Power_kW": 0.0,
"StorageDevices": [],
"Transformers": [
  {
    "current_kVA": 151.64,
    "loading_percent": 50.55,
    "name": "xfmr_neigh_14",
    "rated_kVA": 300.0,
    "status": "OK"
  }
],
"VAngle": -10.013413479612142,
"VMag_pu": 0.7726757394377756
},
{
  "Bus": "300",
  "Coordinates": {
    "X": 3245.0,
    "Y": 4010.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -10.01341579629641,
  "VMag_pu": 0.7726757919124402
},
{
  "Bus": "109",
  "Coordinates": {
    "X": 3975.0,
    "Y": 3050.0
  },
  "DFPs": [],
  "Devices": [],
```

```
"Gen_kW": 0,
"Load_kW": 40.0,
"Net_Power_kW": -40.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -10.01342500715824,
"VMag_pu": 0.7726758970354485
},
{
  "Bus": "110",
  "Coordinates": {
    "X": 4275.0,
    "Y": 3050.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -10.01343130332637,
  "VMag_pu": 0.7726759831129055
},
{
  "Bus": "112",
  "Coordinates": {
    "X": 4275.0,
    "Y": 2925.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -10.013432711476598,
  "VMag_pu": 0.772676002364299
},
```

```

{
  "Bus": "113",
  "Coordinates": {
    "X": 4800.0,
    "Y": 2925.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -10.013436519268971,
  "VMag_pu": 0.7726760544221788
},
{
  "Bus": "114",
  "Coordinates": {
    "X": 5125.0,
    "Y": 2925.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -10.013437171261746,
  "VMag_pu": 0.7726760633358385
},
{
  "Bus": "111",
  "Coordinates": {
    "X": 4275.0,
    "Y": 3625.0
  },
  "DFPs": [],
  "Devices": [],

```

```

    "Gen_kW": 0,
    "Load_kW": 20.0,
    "Net_Power_kW": -20.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -10.013433344179546,
    "VMag_pu": 0.7726760110142403
  },
  {
    "Bus": "106",
    "Coordinates": {
      "X": 3750.0,
      "Y": 2725.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -123.62654801330089,
    "VMag_pu": 1.1382181519945196
  },
  {
    "Bus": "107",
    "Coordinates": {
      "X": 4325.0,
      "Y": 2725.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -123.62655005415408,
    "VMag_pu": 1.1382181930955846
  },

```



```
{
  "Bus": "102",
  "Coordinates": {
    "X": 3750.0,
    "Y": 2450.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": 125.47517711719246,
  "VMag_pu": 1.0622044751302544
},
{
  "Bus": "103",
  "Coordinates": {
    "X": 4075.0,
    "Y": 2450.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": 125.47517365661507,
  "VMag_pu": 1.0622045401690468
},
{
  "Bus": "104",
  "Coordinates": {
    "X": 4775.0,
    "Y": 2450.0
  },
  "DFPs": [],
  "Devices": [],
```

```
"Gen_kW": 0,
"Load_kW": 40.0,
"Net_Power_kW": -40.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": 125.47517063198573,
"VMag_pu": 1.06220459701455
},
{
  "Bus": "98",
  "Coordinates": {
    "X": 3800.0,
    "Y": 2100.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -9.640737342007348,
  "VMag_pu": 0.7793059497750535
},
{
  "Bus": "99",
  "Coordinates": {
    "X": 4350.0,
    "Y": 2100.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -9.640740830146779,
  "VMag_pu": 0.7793060301333362
},
```

```

{
  "Bus": "100",
  "Coordinates": {
    "X": 4650.0,
    "Y": 2100.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -9.640742144685131,
  "VMag_pu": 0.7793060604171196
},
{
  "Bus": "450",
  "Coordinates": {
    "X": 5450.0,
    "Y": 2100.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -9.640743620657963,
  "VMag_pu": 0.7793060944199651
},
{
  "Bus": "72",
  "Coordinates": {
    "X": 3525.0,
    "Y": 1575.0
  },
  "DFPs": [],
  "Devices": [],

```

```
"Gen_kW": 0,
"Load_kW": 0.0,
"Net_Power_kW": 0.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -9.774424126042941,
"VMag_pu": 0.777463425659136
},
{
  "Bus": "76",
  "Coordinates": {
    "X": 3525.0,
    "Y": 1375.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 221.24833310799792,
  "Net_Power_kW": -221.24833310799792,
  "StorageDevices": [],
  "Transformers": [
    {
      "current_kVA": 298.69,
      "loading_percent": 99.56,
      "name": "xfmr_neigh_11",
      "rated_kVA": 300.0,
      "status": "Critical"
    }
  ],
  "VAngle": -9.99547663540569,
  "VMag_pu": 0.7739647326686381
},
{
  "Bus": "86",
  "Coordinates": {
    "X": 3255.0,
    "Y": 725.0
  },
  "DFPs": [],
  "Devices": [],
```

```

    "Gen_kW": 0,
    "Load_kW": 20.0,
    "Net_Power_kW": -20.0,
    "StorageDevices": [],
    "Transformers": [
        {
            "current_kVA": 151.68,
            "loading_percent": 50.56,
            "name": "xfmr_neigh_10",
            "rated_kVA": 300.0,
            "status": "OK"
        }
    ],
    "VAngle": -10.301869113873842,
    "VMag_pu": 0.7693432882131651
},
{
    "Bus": "87",
    "Coordinates": {
        "X": 3050.0,
        "Y": 1125.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -10.343510963079842,
    "VMag_pu": 0.7690175968991292
},
{
    "Bus": "89",
    "Coordinates": {
        "X": 2775.0,
        "Y": 1125.0
    },
    "DFPs": [],
    "Devices": [],

```

```
"Gen_kW": 0,
"Load_kW": 0.0,
"Net_Power_kW": 0.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -10.357129730289628,
"VMag_pu": 0.7684444316580854
},
{
  "Bus": "91",
  "Coordinates": {
    "X": 2550.0,
    "Y": 1125.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -10.359081026297284,
  "VMag_pu": 0.768100339804461
},
{
  "Bus": "93",
  "Coordinates": {
    "X": 2325.0,
    "Y": 1125.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -10.374604078097825,
  "VMag_pu": 0.7678559882347614
},
```

```
{
  "Bus": "95",
  "Coordinates": {
    "X": 2025.0,
    "Y": 1125.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -10.374604556406764,
  "VMag_pu": 0.7678559891418099
},
{
  "Bus": "96",
  "Coordinates": {
    "X": 2025.0,
    "Y": 925.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -123.9311152071907,
  "VMag_pu": 1.1465106164465835
},
{
  "Bus": "94",
  "Coordinates": {
    "X": 2325.0,
    "Y": 850.0
  },
  "DFPs": [],
  "Devices": [],
```

```

    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -10.389870471920352,
    "VMag_pu": 0.7672559112788829
  },
  {
    "Bus": "92",
    "Coordinates": {
      "X": 2550.0,
      "Y": 825.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": 125.64927516077265,
    "VMag_pu": 1.0689546564915646
  },
  {
    "Bus": "90",
    "Coordinates": {
      "X": 2775.0,
      "Y": 900.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -123.95088066377355,
    "VMag_pu": 1.1470551802909472
  },

```



```

{
  "Bus": "88",
  "Coordinates": {
    "X": 2950.0,
    "Y": 1300.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -10.365394269307538,
  "VMag_pu": 0.7693152998898821
},
{
  "Bus": "77",
  "Coordinates": {
    "X": 3925.0,
    "Y": 1375.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 34.73449228777606,
  "Net_Power_kW": -34.73449228777606,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -10.032896025847702,
  "VMag_pu": 0.7745619408379205
},
{
  "Bus": "78",
  "Coordinates": {
    "X": 4025.0,
    "Y": 1375.0
  },
  "DFPs": [],
  "Devices": [],

```

```
"Gen_kW": 0,
"Load_kW": 0.0,
"Net_Power_kW": 0.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -10.04224172770219,
"VMag_pu": 0.7747112920909954
},
{
  "Bus": "80",
  "Coordinates": {
    "X": 4025.0,
    "Y": 900.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 34.73449228777606,
  "Net_Power_kW": -34.73449228777606,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -10.086583370068281,
  "VMag_pu": 0.7754209687192397
},
{
  "Bus": "81",
  "Coordinates": {
    "X": 4025.0,
    "Y": 425.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -10.102899011847798,
  "VMag_pu": 0.7756825400839332
},
```

```

{
  "Bus": "84",
  "Coordinates": {
    "X": 4700.0,
    "Y": 425.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 17.36724614388803,
  "Net_Power_kW": -17.36724614388803,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": 125.47417048881606,
  "VMag_pu": 1.071430965191369
},
{
  "Bus": "85",
  "Coordinates": {
    "X": 4700.0,
    "Y": 900.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 34.73449228777606,
  "Net_Power_kW": -34.73449228777606,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": 125.47416909609775,
  "VMag_pu": 1.0714309915937614
},
{
  "Bus": "82",
  "Coordinates": {
    "X": 4025.0,
    "Y": 175.0
  },
  "DFPs": [],
  "Devices": [],

```

```

    "Gen_kW": 0,
    "Load_kW": 34.73449228777606,
    "Net_Power_kW": -34.73449228777606,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -10.126189418105477,
    "VMag_pu": 0.776056329916167
  },
  {
    "Bus": "83",
    "Coordinates": {
      "X": 4275.0,
      "Y": 175.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 17.36724614388803,
    "Net_Power_kW": -17.36724614388803,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -10.149457070219965,
    "VMag_pu": 0.776430241956416
  },
  {
    "Bus": "79",
    "Coordinates": {
      "X": 4250.0,
      "Y": 1375.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 34.73449228777606,
    "Net_Power_kW": -34.73449228777606,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -10.042241859583125,
    "VMag_pu": 0.7747112944804797
  },

```

```
{
  "Bus": "73",
  "Coordinates": {
    "X": 3800.0,
    "Y": 1575.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": 125.44778444519464,
  "VMag_pu": 1.0641100217911676
},
{
  "Bus": "74",
  "Coordinates": {
    "X": 4150.0,
    "Y": 1575.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": 125.44778196067766,
  "VMag_pu": 1.0641100685694524
},
{
  "Bus": "75",
  "Coordinates": {
    "X": 4550.0,
    "Y": 1575.0
  },
  "DFPs": [],
  "Devices": [],
```

```
"Gen_kW": 0,
"Load_kW": 40.0,
"Net_Power_kW": -40.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": 125.44778097304362,
"VMag_pu": 1.064110087164548
},
{
  "Bus": "68",
  "Coordinates": {
    "X": 3725.0,
    "Y": 1850.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -9.473715606198292,
  "VMag_pu": 0.7822928587536297
},
{
  "Bus": "69",
  "Coordinates": {
    "X": 4000.0,
    "Y": 1850.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -9.473718110005063,
  "VMag_pu": 0.78229289341023
},
```

```
{
  "Bus": "70",
  "Coordinates": {
    "X": 4325.0,
    "Y": 1850.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -9.473719865370281,
  "VMag_pu": 0.782292917707231
},
{
  "Bus": "71",
  "Coordinates": {
    "X": 4600.0,
    "Y": 1850.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -9.473720332181678,
  "VMag_pu": 0.7822929241686313
},
{
  "Bus": "62",
  "Coordinates": {
    "X": 3075.0,
    "Y": 2100.0
  },
  "DFPs": [],
  "Devices": [],
```

```
"Gen_kW": 0,
"Load_kW": 40.0,
"Net_Power_kW": -40.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -8.731641437242208,
"VMag_pu": 0.7954856395544726
},
{
  "Bus": "63",
  "Coordinates": {
    "X": 3075.0,
    "Y": 2275.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -8.731668164362045,
  "VMag_pu": 0.7954857178138837
},
{
  "Bus": "64",
  "Coordinates": {
    "X": 3075.0,
    "Y": 2625.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 75.0,
  "Net_Power_kW": -75.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -8.731709802387885,
  "VMag_pu": 0.7954858397340127
},
```



```

{
  "Bus": "65",
  "Coordinates": {
    "X": 2650.0,
    "Y": 2625.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 140.0,
  "Net_Power_kW": -140.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -8.731739182104802,
  "VMag_pu": 0.7954859257608219
},
{
  "Bus": "66",
  "Coordinates": {
    "X": 2650.0,
    "Y": 2300.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 75.0,
  "Net_Power_kW": -75.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -8.731745974404909,
  "VMag_pu": 0.7954859456493943
},
{
  "Bus": "61",
  "Coordinates": {
    "X": 3075.0,
    "Y": 1300.0
  },
  "DFPs": [],
  "Devices": [],

```

```

    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -8.731597132207312,
    "VMag_pu": 0.7954855253739812
  },
  {
    "Bus": "61s",
    "Coordinates": {
      "X": 3175.0,
      "Y": 1300.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -8.73159713188071,
    "VMag_pu": 0.7954855253689306
  },
  {
    "Bus": "58",
    "Coordinates": {
      "X": 2075.0,
      "Y": 1850.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 20.0,
    "Net_Power_kW": -20.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -122.67613012810763,
    "VMag_pu": 1.0941789071243988
  },

```

```

{
  "Bus": "59",
  "Coordinates": {
    "X": 1825.0,
    "Y": 1850.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -122.67613051390217,
  "VMag_pu": 1.0941789145933603
},
{
  "Bus": "55",
  "Coordinates": {
    "X": 2600.0,
    "Y": 1500.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -6.076693383564685,
  "VMag_pu": 0.8489254338243376
},
{
  "Bus": "56",
  "Coordinates": {
    "X": 2875.0,
    "Y": 1500.0
  },
  "DFPs": [],
  "Devices": [],

```

```

    "Gen_kW": 0,
    "Load_kW": 20.0,
    "Net_Power_kW": -20.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -6.076693537475085,
    "VMag_pu": 0.8489254389334803
  },
  {
    "Bus": "18",
    "Coordinates": {
      "X": 1500.0,
      "Y": 2325.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [
      {
        "current_kVA": 139.28,
        "loading_percent": 46.43,
        "name": "xfmr_neigh_5",
        "rated_kVA": 300.0,
        "status": "OK"
      }
    ],
    "VAngle": -5.271718931828803,
    "VMag_pu": 0.8656164984356396
  },
  {
    "Bus": "135",
    "Coordinates": {
      "X": 1600.0,
      "Y": 2325.0
    },
    "DFPs": [],
    "Devices": [],

```

```

    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -5.273172410700282,
    "VMag_pu": 0.8654987426220531
  },
  {
    "Bus": "35",
    "Coordinates": {
      "X": 1975.0,
      "Y": 2325.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [
      {
        "current_kVA": 120.62,
        "loading_percent": 40.21,
        "name": "xfmr_neigh_7",
        "rated_kVA": 300.0,
        "status": "OK"
      }
    ],
    "VAngle": -5.520760926992981,
    "VMag_pu": 0.8595935960253333
  },
  {
    "Bus": "40",
    "Coordinates": {
      "X": 1975.0,
      "Y": 2575.0
    },
    "DFPs": [],
    "Devices": [],

```

```

    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -5.634281551587305,
    "VMag_pu": 0.8566970193801331
  },
  {
    "Bus": "42",
    "Coordinates": {
      "X": 1975.0,
      "Y": 2825.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 11.02453493247725,
    "Net_Power_kW": -11.02453493247725,
    "StorageDevices": [],
    "Transformers": [
      {
        "current_kVA": 298.33,
        "loading_percent": 99.44,
        "name": "xfmr_neigh_8",
        "rated_kVA": 300.0,
        "status": "Critical"
      }
    ],
    "VAngle": -5.7485720757610554,
    "VMag_pu": 0.8538038216850415
  },
  {
    "Bus": "44",
    "Coordinates": {
      "X": 1975.0,
      "Y": 3025.0
    },
    "DFPs": [],
    "Devices": [],

```

```
"Gen_kW": 0,
"Load_kW": 0.0,
"Net_Power_kW": 0.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -5.748575791083417,
"VMag_pu": 0.8538038690221723
},
{
  "Bus": "47",
  "Coordinates": {
    "X": 1975.0,
    "Y": 3275.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 57.87880839550556,
  "Net_Power_kW": -57.87880839550556,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -5.748579674981743,
  "VMag_pu": 0.853803901881893
},
{
  "Bus": "49",
  "Coordinates": {
    "X": 2225.0,
    "Y": 3275.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 88.7087482972748,
  "Net_Power_kW": -88.7087482972748,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -5.748582309510821,
  "VMag_pu": 0.8538039246127386
},
```

```

{
  "Bus": "50",
  "Coordinates": {
    "X": 2475.0,
    "Y": 3275.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 22.0490698649545,
  "Net_Power_kW": -22.0490698649545,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -5.748584358580017,
  "VMag_pu": 0.8538039422922622
},
{
  "Bus": "51",
  "Coordinates": {
    "X": 2725.0,
    "Y": 3275.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 11.02453493247725,
  "Net_Power_kW": -11.02453493247725,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -5.748585822189356,
  "VMag_pu": 0.8538039549204633
},
{
  "Bus": "151",
  "Coordinates": {
    "X": 3187.0,
    "Y": 3928.0
  },
  "DFPs": [],
  "Devices": [],

```



```

    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -5.748586993028528,
    "VMag_pu": 0.8538039650228958
  },
  {
    "Bus": "300_open",
    "Coordinates": {
      "X": 0.0,
      "Y": 0.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -5.748586993028528,
    "VMag_pu": 0.8538039650228958
  },
  {
    "Bus": "48",
    "Coordinates": {
      "X": 1825.0,
      "Y": 3275.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 115.75761679101112,
    "Net_Power_kW": -115.75761679101112,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -5.748579780364493,
    "VMag_pu": 0.8538039027911307
  },

```

```

{
  "Bus": "45",
  "Coordinates": {
    "X": 2175.0,
    "Y": 3025.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 11.02453493247725,
  "Net_Power_kW": -11.02453493247725,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -5.748576778717463,
  "VMag_pu": 0.8538038839422117
},
{
  "Bus": "46",
  "Coordinates": {
    "X": 2475.0,
    "Y": 3025.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 11.02453493247725,
  "Net_Power_kW": -11.02453493247725,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -5.748577334261595,
  "VMag_pu": 0.853803892334734
},
{
  "Bus": "43",
  "Coordinates": {
    "X": 2475.0,
    "Y": 2825.0
  },
  "DFPs": [],
  "Devices": [],

```

```

    "Gen_kW": 0,
    "Load_kW": 22.0490698649545,
    "Net_Power_kW": -22.0490698649545,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -122.09173465117003,
    "VMag_pu": 1.0759967135814232
  },
  {
    "Bus": "41",
    "Coordinates": {
      "X": 2300.0,
      "Y": 2575.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 20.0,
    "Net_Power_kW": -20.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": 123.51879339367319,
    "VMag_pu": 1.0100780665254476
  },
  {
    "Bus": "36",
    "Coordinates": {
      "X": 2075.0,
      "Y": 2000.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -5.520764236559774,
    "VMag_pu": 0.8595936331316011
  },

```

```
{
  "Bus": "38",
  "Coordinates": {
    "X": 2325.0,
    "Y": 2000.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -122.01783135068618,
  "VMag_pu": 1.0733206012396987
},
{
  "Bus": "39",
  "Coordinates": {
    "X": 2650.0,
    "Y": 2000.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -122.01783200267897,
  "VMag_pu": 1.0733206136216205
},
{
  "Bus": "37",
  "Coordinates": {
    "X": 1775.0,
    "Y": 2000.0
  },
  "DFPs": [],
  "Devices": [],
```

```
"Gen_kW": 0,
"Load_kW": 40.0,
"Net_Power_kW": -40.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -5.520764792103916,
"VMag_pu": 0.8595936415810342
},
{
  "Bus": "21",
  "Coordinates": {
    "X": 1500.0,
    "Y": 2625.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -5.361370584254968,
  "VMag_pu": 0.8638281350398315
},
{
  "Bus": "23",
  "Coordinates": {
    "X": 1500.0,
    "Y": 2875.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -5.436363377419075,
  "VMag_pu": 0.8623394535763936
},
```

```
{
  "Bus": "25",
  "Coordinates": {
    "X": 1500.0,
    "Y": 3150.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -5.519155352659556,
  "VMag_pu": 0.8607036129889764
},
{
  "Bus": "25r",
  "Coordinates": {
    "X": 1500.0,
    "Y": 3150.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [
    {
      "current_kVA": 170.8,
      "loading_percent": 56.93,
      "name": "xfmr_neigh_6",
      "rated_kVA": 300.0,
      "status": "OK"
    }
  ],
  "VAngle": -5.5197345321503395,
  "VMag_pu": 0.8606988400487777
},
```

```
{
  "Bus": "26",
  "Coordinates": {
    "X": 1150.0,
    "Y": 3150.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -5.519734863128009,
  "VMag_pu": 0.8606988858322605
},
{
  "Bus": "31",
  "Coordinates": {
    "X": 1150.0,
    "Y": 3375.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": 123.47061489253673,
  "VMag_pu": 1.0094629779284672
},
{
  "Bus": "32",
  "Coordinates": {
    "X": 1150.0,
    "Y": 3675.0
  },
  "DFPs": [],
  "Devices": [],
```

```
"Gen_kW": 0,
"Load_kW": 20.0,
"Net_Power_kW": -20.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": 123.47061433699257,
"VMag_pu": 1.009462987851051
},
{
  "Bus": "27",
  "Coordinates": {
    "X": 875.0,
    "Y": 3150.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -5.519735538591433,
  "VMag_pu": 0.8606989120724994
},
{
  "Bus": "33",
  "Coordinates": {
    "X": 875.0,
    "Y": 3650.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -5.5197370817696285,
  "VMag_pu": 0.860698935573326
},
```



```

{
  "Bus": "28",
  "Coordinates": {
    "X": 1500.0,
    "Y": 3350.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -5.519156325105121,
  "VMag_pu": 0.8607036346725374
},
{
  "Bus": "29",
  "Coordinates": {
    "X": 1500.0,
    "Y": 3650.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -5.51915739991335,
  "VMag_pu": 0.860703658638579
},
{
  "Bus": "30",
  "Coordinates": {
    "X": 1850.0,
    "Y": 3650.0
  },
  "DFPs": [],
  "Devices": [],

```

```
"Gen_kW": 0,
"Load_kW": 40.0,
"Net_Power_kW": -40.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -5.519158071668471,
"VMag_pu": 0.8607036736173551
},
{
  "Bus": "250",
  "Coordinates": {
    "X": 2050.0,
    "Y": 3650.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -5.5191581740311575,
  "VMag_pu": 0.8607036758998353
},
{
  "Bus": "24",
  "Coordinates": {
    "X": 950.0,
    "Y": 2875.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": 123.41740158532126,
  "VMag_pu": 1.0095460520345159
},
```

```
{
  "Bus": "22",
  "Coordinates": {
    "X": 975.0,
    "Y": 2625.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -121.96742298181061,
  "VMag_pu": 1.0717381183613162
},
{
  "Bus": "19",
  "Coordinates": {
    "X": 1250.0,
    "Y": 2325.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -5.271720320689183,
  "VMag_pu": 0.8656165197072275
},
{
  "Bus": "20",
  "Coordinates": {
    "X": 925.0,
    "Y": 2325.0
  },
  "DFPs": [],
  "Devices": [],
```

```
"Gen_kW": 0,
"Load_kW": 40.0,
"Net_Power_kW": -40.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -5.271720972681951,
"VMag_pu": 0.8656165296930567
},
{
  "Bus": "34",
  "Coordinates": {
    "X": 1500.0,
    "Y": 1350.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": 122.62795300181936,
  "VMag_pu": 1.0102400227454194
},
{
  "Bus": "15",
  "Coordinates": {
    "X": 1500.0,
    "Y": 1250.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": 122.62795204504887,
  "VMag_pu": 1.010240039847468
},
```

```
{
  "Bus": "17",
  "Coordinates": {
    "X": 1850.0,
    "Y": 1250.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": 122.62795128889157,
  "VMag_pu": 1.0102400533636036
},
{
  "Bus": "16",
  "Coordinates": {
    "X": 1500.0,
    "Y": 875.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": 122.62795117701116,
  "VMag_pu": 1.0102400553634396
},
{
  "Bus": "9",
  "Coordinates": {
    "X": 1200.0,
    "Y": 1725.0
  },
  "DFPs": [],
  "Devices": [],
```

```
"Gen_kW": 0,
"Load_kW": 40.0,
"Net_Power_kW": -40.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -3.22063181609293,
"VMag_pu": 0.9135070683039987
},
{
  "Bus": "9r",
  "Coordinates": {
    "X": 1200.0,
    "Y": 1725.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -3.2206318161060183,
  "VMag_pu": 0.9135070685126381
},
{
  "Bus": "14",
  "Coordinates": {
    "X": 1200.0,
    "Y": 2150.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -3.220635554455347,
  "VMag_pu": 0.9135071289363754
},
```

```

{
  "Bus": "10",
  "Coordinates": {
    "X": 1450.0,
    "Y": 2150.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -3.220635940249886,
  "VMag_pu": 0.9135071351720554
},
{
  "Bus": "11",
  "Coordinates": {
    "X": 950.0,
    "Y": 2150.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -3.220635940249886,
  "VMag_pu": 0.9135071351720554
},
{
  "Bus": "12",
  "Coordinates": {
    "X": 1200.0,
    "Y": 1275.0
  },
  "DFPs": [],
  "Devices": [],

```

```
"Gen_kW": 0,
"Load_kW": 20.0,
"Net_Power_kW": -20.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -121.31223342925213,
"VMag_pu": 1.0469355412107475
},
{
  "Bus": "3",
  "Coordinates": {
    "X": 700.0,
    "Y": 1250.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": 120.9319403741633,
  "VMag_pu": 1.0031027505000747
},
{
  "Bus": "5",
  "Coordinates": {
    "X": 1025.0,
    "Y": 1250.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": 120.9319387191047,
  "VMag_pu": 1.0031027798748533
},
```



```
{
  "Bus": "6",
  "Coordinates": {
    "X": 1275.0,
    "Y": 1150.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": 120.93193833331016,
  "VMag_pu": 1.0031027867221212
},
{
  "Bus": "4",
  "Coordinates": {
    "X": 700.0,
    "Y": 1050.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": 120.9319401272548,
  "VMag_pu": 1.003102754882326
},
{
  "Bus": "2",
  "Coordinates": {
    "X": 700.0,
    "Y": 1675.0
  },
  "DFPs": [],
  "Devices": [],
```

```

    "Gen_kW": 0,
    "Load_kW": 20.0,
    "Net_Power_kW": -20.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -120.61231672188734,
    "VMag_pu": 1.0215717617261029
  },
  {
    "Bus": "610",
    "Coordinates": {
      "X": 3275.0,
      "Y": 1300.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -3.157499911245789,
    "VMag_pu": 0.9255647654223887
  },
  {
    "Bus": "150r",
    "Coordinates": {
      "X": 100.0,
      "Y": 1500.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -0.003211468321421869,
    "VMag_pu": 0.9999607103977791
  }
}

```

```
],
"dfp_registry": [],
"management_status": {
  "management_log": [
    "System stabilized in 1 iteration(s)."
  ],
  "status": "OK"
},
"neighborhood_details": {
  "1": [
    "150",
    "150r",
    "149",
    "1",
    "2",
    "197",
    "3",
    "4",
    "5",
    "6",
    "7"
  ],
  "2": [
    "8",
    "9",
    "10",
    "11",
    "12",
    "14",
    "9r"
  ],
  "3": [
    "13",
    "15",
    "16",
    "17",
    "34",
    "52",
    "53",
    "152"
```

```
],  
"4": [  
    "54",  
    "55",  
    "56",  
    "57",  
    "58",  
    "59"  
],  
"5": [  
    "18",  
    "19",  
    "20",  
    "21",  
    "22",  
    "23",  
    "24",  
    "135"  
],  
"6": [  
    "25r",  
    "25",  
    "26",  
    "27",  
    "28",  
    "29",  
    "30",  
    "31",  
    "32",  
    "33",  
    "250"  
],  
"7": [  
    "35",  
    "36",  
    "37",  
    "38",  
    "39",  
    "40",  
    "41"
```

```
],
"8": [
    "42",
    "43",
    "44",
    "45",
    "46",
    "47",
    "48",
    "49",
    "50",
    "51",
    "151"
],
"9": [
    "60",
    "61",
    "62",
    "63",
    "64",
    "65",
    "66",
    "61s",
    "610",
    "160r"
],
"10": [
    "86",
    "87",
    "88",
    "89",
    "90",
    "91",
    "92",
    "93",
    "94_open",
    "95",
    "96"
],
"11": [
```

```
"76",
"77",
"78",
"79",
"80",
"81",
"82",
"83",
"84",
"85"
],
"12": [
    "67",
    "68",
    "69",
    "70",
    "71",
    "72",
    "73",
    "74",
    "75"
],
"13": [
    "97",
    "98",
    "99",
    "100",
    "101",
    "102",
    "103",
    "104",
    "197",
    "450"
],
"14": [
    "105",
    "106",
    "107",
    "108",
    "109",
```

```

        "110",
        "111",
        "112",
        "113",
        "114",
        "300_open"
    ]
},
"power_summary": {
    "circuit_loading_percent": -11.24,
    "converged": true,
    "maximum_circuit_load_kW": 3490.0,
    "maximum_circuit_power_kVA": 21350.0,
    "total_circuit_power_kW": -2400.4,
    "total_gen_kW": 0,
    "total_load_kW": 3170.2,
    "total_losses_kW": 261.2745
},
"voltage_profile": {
    "avg_voltage_pu": 0.8863,
    "max_voltage_pu": 1.1471,
    "min_voltage_pu": 0.7673
}
},
"status": "success"
}

```

## API 2: add generator

### Parameters:

```

"bus_name": "25",
"phases": 1,
"kw": 6000

```

### Description:

This API simulates the installation of a new distributed generation unit, such as a large solar panel array or a micro-generator, at a specific point (bus) in the power grid. The kw parameter defines the power output of the new generator. This allows for analyzing the impact of adding new energy sources on the local and overall grid stability, voltage, and power flow.

Response:

```
{
  "details": {
    "bus_name": "1",
    "generator_name": "Gen_1_60kW",
    "kw": 60.0,
    "phases": 1
  },
  "message": "Generator 'Gen_1_60kW' of 60.0 kW added to bus '1'.",
  "status": "success"
}
```

### API 3: modify load neighborhood

Parameters:

```
"neighbourhood": 3,
"factor": 0.8
```

Description:

This API simulates a widespread change in electricity consumption across an entire neighborhood or service area. The factor parameter adjusts the load of all houses within the specified neighbourhood. A factor of 0.75 would simulate a 25% reduction in demand across the area, which could be due to a public awareness campaign or a coordinated energy-saving event. Conversely, a factor of 1.2 would simulate a 20% increase in demand.

Response:

```
{
  "details": {
    "modified_bus_count": 5,
    "modified_buses": [
      {
        "bus_name": "16",
        "load_reduction_kw": 8.0
      },
      {
        "bus_name": "17",
        "load_reduction_kw": 4.0
      },
      {
        "bus_name": "34",
```



```

        "load_reduction_kw": 8.0
    },
    {
        "bus_name": "52",
        "load_reduction_kw": 8.0
    },
    {
        "bus_name": "53",
        "load_reduction_kw": 8.0
    }
],
"total_load_reduction_kw": 36.0,
"unmodified_bus_count": 3,
"unmodified_buses": [
    {
        "bus_name": "13",
        "reason": "No load found for bus '13'."
    },
    {
        "bus_name": "15",
        "reason": "No load found for bus '15'."
    },
    {
        "bus_name": "152",
        "reason": "No load found for bus '152'."
    }
]
},
"message": "Attempted to modify loads in neighborhood 3 with factor 0.8.",
"status": "success"
}

```

#### API 4: modify load in node

##### Parameters:

```

"bus_name": "1",
"factor": 0.9

```

##### Description:

This API simulates a change in electricity usage for a single household or customer, identified by their bus\_name. The factor adjusts the household's net power consumption. A factor of 0.5 represents a 50% reduction in the power being drawn from the grid. This

is useful for modeling the impact of individual consumer behavior, such as turning off major appliances or responding to a direct request from the utility to conserve energy.

Response:

```
{
  "load_reduction_kw": 3.2,
  "message": "Load modified on bus 16.",
  "status": "success"
}
```

## API 5: add device

Parameters:

```
"bus_name": "1",
"device_name": "television",
"phases": 1,
"kw": 20
```

Description:

This API simulates a consumer adding a new, significant electrical appliance to their home. It models the connection of a new device with a specific power draw (kw) to a household (bus\_name). This is commonly used to simulate the impact of new high-consumption devices like electric vehicle (EV) chargers or heat pumps on the local transformer and the wider grid.

Response:

```
{
  "details": {
    "bus_name": "1",
    "device_name": "television",
    "kw": 20.0,
    "opendss_load_name": "dev_television"
  },
  "message": "Device 'television' (20.0 kW) added to bus '1'.",
  "status": "success"
}
```

## API 6: create dfp

Parameters:

```
"name": "Peak Power Shaving 1",
"min_power_kw": 40.0,
"target_pf": 0.8
```

### Description

This API simulates a utility company creating a Demand Flexibility Program and adding it into their database. The minimum power is the threshold of a device after which the DFP is applied. The target power factor is the factor by which the load is decreased on any device crossing the threshold. For example, when applied, any device with a load over 40 KW will have its load decreased by 20%.

### Response:

```
{
  "dfp_details": {
    "description": "I hate DFPs",
    "index": 2,
    "min_power_kw": 100.0,
    "name": "Peak Power Shaving 3",
    "registered_at": "2025-07-11 15:56:58",
    "target_pf": 0.9
  },
  "message": "DFP 'Peak Power Shaving 3' registered successfully with index 2.",
  "status": "success"
}
```

## API 7: subscribe dfp

### Parameters:

```
"bus_name": "1",
"dfp_name": "Peak Power Shaving 1"
```

### Description:

Simulates an individual node subscribing to a DFP plan and allowing its load values to be affected by the grid. In this case, household 1 will subscribe to Peak Power Shaving 1 and when run, any device over the load capacity will be reduced.

### Response:

```
{
  "message": "Successfully subscribed bus '1' to DFP 'Peak Power Shaving 2'.",
  "status": "success"
}
```

## API 8: modify dfp

### Parameters:

```
"name": "Peak Power Shaving 1",
"min_power_kw": 12.0,
```

"target\_pf": 0.8

Description:

Allows the grid company to modify an existing Demand Flexibility Program and change its minimum power threshold and target power factor. It will throw an error if the DFP's name is not found in the database.

Response:

```
{
  "data": {
    "description": "I really really hate DFPs",
    "index": 1,
    "min_power_kw": 15.0,
    "name": "Peak Power Shaving 2",
    "registered_at": "2025-07-11 15:56:18",
    "target_pf": 0.8
  },
  "status": "success"
}
```

## API 9: execute dfp

Parameters:

"dfp\_name": "Peak Power Shaving 2"

Description:

This runs a particular DFP for all buses that participate. It runs a loop to identify all the buses participating in the given program. It will then find devices and reduce their load by calling API 12 depending on how the DFP is defined. For example, if a DFP is defined to reduce load by 20% for all devices greater than 40kW, running this API will find all houses that participate in this DFP, identify all devices over 40kW, and reduce their load by a factor of .8.

Response:

```
{
  "details": [
    "Bus '150': Chose not to participate",
    "Bus '149': No devices found on bus '149'.",
    "Bus '1': Chose not to participate",
    "Bus '7': No devices found on bus '7'.",
    "Bus '3': No devices found on bus '3'.",
    "Bus '5': No devices found on bus '5'.",
    "Bus '4': Chose not to participate",
    "Bus '2': Chose not to participate"
  ]
}
```

```

],
"dfp_details": {
  "description": "I really really hate DFPs",
  "index": 1,
  "min_power_kw": 15.0,
  "name": "Peak Power Shaving 2",
  "registered_at": "2025-07-11 15:56:18",
  "target_pf": 0.8
},
"message": "Executed DFP 'Peak Power Shaving 2' on 8 bus(es).",
"status": "success"
}

```

## API 10: unsubscribe dfp

### Parameters:

```

"name": "Peak Power Shaving 1",
"min_power_kw": 12.0,
"target_pf": 0.8

```

### Description:

Opposite of API 7; it will remove a node from a particular DFP plan if they do not want to participate.

### Response:

```

{
  "message": "Successfully unsubscribed bus '1' from DFP 'Peak Power Shaving 2'.",
  "status": "success"
}

```

## API 11: delete dfp

### Parameters:

```

"name": "Peak Power Shaving 1"

```

### Description:

Opposite of API 6; it will remove a DFP from the database if the utility company no longer wants to run a particular program.

### Response:

```

{
  "message": "DFP 'Peak Power Shaving 2' deleted successfully.",
  "status": "success"
}

```

## API 12: modify load device

### Parameters:

```
"bus_name": "1",  
"power_threshold_kw": 20,  
"reduction_factor": 0.8
```

### Description:

Similar to API 3 and 4. It will decrease all devices within a household that cross the power threshold by the given factor.

### Response:

```
{  
  "message": "Modified 1 devices on bus '1'. Total load reduced by 4.00 kW.",  
  "status": "success"  
}
```

## API 13: disconnect device

### Parameters:

```
"bus_name": "1",  
"device_name": "television"
```

### Description:

This API simulates the removal or disabling of a specific electrical device from a household. It identifies the device by its device\_name at a given bus\_name and removes its load from the simulation.

### Response:

```
{  
  "details": {  
    "bus_name": "1",  
    "device_name": "television",  
    "kw_removed": 16.0  
  },  
  "message": "Device 'television' disconnected from bus '1'.",  
  "status": "success"  
}
```

## API 14: add storage

### Parameters:

```
"bus_name": "1",  
"device_name": "MyBattery",
```

```
"max_capacity_kwh": 20.0,  
"charge_rate_kw": 40.0,  
"discharge_rate_kw": 2.0
```

Description:

This API adds a storage unit (like battery) to a particular household. A node can contain multiple uniquely named storages. When registering, the maximum capacity, the charge rate (when it acts as a load) and discharge rate (when it acts as a generator) are all stored.

Response:

```
{  
  "details": {  
    "active": true,  
    "actual_charge_rate": 40.0,  
    "actual_discharge_rate": 0,  
    "build_charge_rate": 40.0,  
    "build_discharge_rate": 2.0,  
    "bus_name": "1",  
    "current_energy_kwh": 0.3751680056254069,  
    "last_update_time": 1752230013.7686849,  
    "max_capacity_kwh": 20.0,  
    "mode": "load",  
    "opendss_gen_name": "stor_gen_mybattery",  
    "opendss_load_name": "stor_load_mybattery"  
  },  
  "message": "Storage device 'MyBattery' added to bus '1' in load mode.",  
  "status": "success"  
}
```

## API 15: toggle storage

Parameters:

```
"bus_name": "1",  
"device_name": "MyBattery",  
"action": "toggle"
```

Description:

This simulates a storage unit going from a load to a generator or vice versa; in other words charging a battery or using the battery. The action 'toggle' will switch a storage unit between these two states and convert it from charging to discharging or vice versa. The action 'disconnect' will disconnect the storage device from the simulation.

Response:

```
{
  "message": "Storage device 'MyBattery' toggled to GENERATOR mode.",
  "status": "success"
}
```

## API 16: upload zip file

### Parameters:

Form-data - file: IEEE\_8500\_Bus-G.zip

### Description:

This API allows the grid to upload a new map of buses and run the simulation on it. It receives a .zip file from the user and extracts its contents to the Test\_Systems directory so that it is available to the server to use. Essentially it takes a given OpenDSS model and places it in the correct directory. It deleted the original zip file after it's done.

### Response:

```
{
  "message": "Test system 'IEEE_8500_Bus-G.zip' uploaded and extracted to
'c:\\Users\\tarun\\BITS\\Eco      Yr      2      CDCs\\PS-1\\opendss_testing      -
Copy\\Test_Systems\\IEEE_8500_Bus-G'.",
  "status": "success"
}
```

## API 17: switch test system

### Parameters:

"system\_name": "IEEE\_8500\_Bus-G"

### Description:

This stops using the current OpenDSS file and instead switches to the given test system. This allows the simulation to be run off a different map. It creates a brand new OpenDSSCircuit Object.

### Response:

```
{
  "message": "Switched to test system 'IEEE_123_Bus-G'.",
  "results": {
    "bus_details": [
      {
        "Bus": "150",
```



```
"Coordinates": {
  "X": 100.0,
  "Y": 1500.0
},
"DFPs": [],
"Devices": [],
"Gen_kW": 0,
"Load_kW": 0.0,
"Net_Power_kW": 0.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -0.002389991365347438,
"VMag_pu": 0.9999709194847864
},
{
  "Bus": "149",
  "Coordinates": {
    "X": 300.0,
    "Y": 1500.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -0.010456161114586787,
  "VMag_pu": 0.9992527881808037
},
{
  "Bus": "1",
  "Coordinates": {
    "X": 700.0,
    "Y": 1500.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
```

```
"Net_Power_kW": -40.0,
"StorageDevices": [],
"Transformers": [
  {
    "current_kVA": 195.33,
    "loading_percent": 65.11,
    "name": "xfmr_neigh_1",
    "rated_kVA": 300.0,
    "status": "OK"
  }
],
"VAngle": -1.430968197646482,
"VMag_pu": 0.9594130742907941
},
{
  "Bus": "7",
  "Coordinates": {
    "X": 1000.0,
    "Y": 1500.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -2.4836181101588806,
  "VMag_pu": 0.9317593364418078
},
{
  "Bus": "8",
  "Coordinates": {
    "X": 1200.0,
    "Y": 1500.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
```

```
"Net_Power_kW": 0.0,
"StorageDevices": [],
"Transformers": [
  {
    "current_kVA": 116.95,
    "loading_percent": 38.98,
    "name": "xfmr_neigh_2",
    "rated_kVA": 300.0,
    "status": "OK"
  }
],
"VAngle": -3.220628934208017,
"VMag_pu": 0.9135070217234847
},
{
  "Bus": "13",
  "Coordinates": {
    "X": 1500.0,
    "Y": 1500.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [
    {
      "current_kVA": 166.93,
      "loading_percent": 55.64,
      "name": "xfmr_neigh_3",
      "rated_kVA": 300.0,
      "status": "OK"
    }
  ],
  "VAngle": -4.321066277844254,
  "VMag_pu": 0.8875531342639326
},
{
  "Bus": "152",
```

```
"Coordinates": {
  "X": 1600.0,
  "Y": 1500.0
},
"DFPs": [],
"Devices": [],
"Gen_kW": 0,
"Load_kW": 0.0,
"Net_Power_kW": 0.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -4.327293659844598,
"VMag_pu": 0.8871808681706731
},
{
  "Bus": "52",
  "Coordinates": {
    "X": 2000.0,
    "Y": 1500.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -5.273373749467952,
  "VMag_pu": 0.8659741713584911
},
{
  "Bus": "53",
  "Coordinates": {
    "X": 2200.0,
    "Y": 1500.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
```

```
"Net_Power_kW": -40.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -5.763936286130592,
"VMag_pu": 0.8554626417952576
},
{
  "Bus": "54",
  "Coordinates": {
    "X": 2325.0,
    "Y": 1500.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [
    {
      "current_kVA": 67.55,
      "loading_percent": 22.52,
      "name": "xfmr_neigh_4",
      "rated_kVA": 300.0,
      "status": "OK"
    }
  ],
  "VAngle": -6.0766929218334615,
  "VMag_pu": 0.8489254184969102
},
{
  "Bus": "94_open",
  "Coordinates": {
    "X": 0.0,
    "Y": 0.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
```

```
"Net_Power_kW": 0.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -6.0766929218334615,
"VMag_pu": 0.8489254184969102
},
{
  "Bus": "57",
  "Coordinates": {
    "X": 2325.0,
    "Y": 1850.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -6.884359396309772,
  "VMag_pu": 0.8317327780290756
},
{
  "Bus": "60",
  "Coordinates": {
    "X": 3075.0,
    "Y": 1850.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [
    {
      "current_kVA": 278.68,
      "loading_percent": 92.89,
      "name": "xfmr_neigh_9",
      "rated_kVA": 300.0,
```

```
        "status": "OK"
      }
    ],
    "VAngle": -8.731596423130965,
    "VMag_pu": 0.7954855077494127
  },
  {
    "Bus": "160",
    "Coordinates": {
      "X": 3175.0,
      "Y": 1850.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -8.738838673569134,
    "VMag_pu": 0.7952241337663687
  },
  {
    "Bus": "160r",
    "Coordinates": {
      "X": 3175.0,
      "Y": 1850.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -8.742598335669497,
    "VMag_pu": 0.7952008869612661
  },
  {
    "Bus": "67",
```

```
"Coordinates": {
  "X": 3525.0,
  "Y": 1850.0
},
"DFPs": [],
"Devices": [],
"Gen_kW": 0,
"Load_kW": 0.0,
"Net_Power_kW": 0.0,
"StorageDevices": [],
"Transformers": [
  {
    "current_kVA": 170.09,
    "loading_percent": 56.7,
    "name": "xfmr_neigh_12",
    "rated_kVA": 300.0,
    "status": "OK"
  }
],
"VAngle": -9.473713198840036,
"VMag_pu": 0.7822928254320309
},
{
  "Bus": "97",
  "Coordinates": {
    "X": 3525.0,
    "Y": 2100.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -9.640735074716511,
  "VMag_pu": 0.7793058975421726
},
{
  "Bus": "197",
```



```
"Coordinates": {
  "X": 3525.0,
  "Y": 2200.0
},
"DFPs": [],
"Devices": [],
"Gen_kW": 0,
"Load_kW": 0.0,
"Net_Power_kW": 0.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -9.642671832989404,
"VMag_pu": 0.7792129296215656
},
{
  "Bus": "101",
  "Coordinates": {
    "X": 3525.0,
    "Y": 2450.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [
    {
      "current_kVA": 153.62,
      "loading_percent": 51.21,
      "name": "xfmr_neigh_13",
      "rated_kVA": 300.0,
      "status": "OK"
    }
  ],
  "VAngle": -9.81100259611622,
  "VMag_pu": 0.7762326948652664
},
{
  "Bus": "105",
```

```

    "Coordinates": {
      "X": 3525.0,
      "Y": 2725.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -9.903544168734372,
    "VMag_pu": 0.7746012222957545
  },
  {
    "Bus": "108",
    "Coordinates": {
      "X": 3525.0,
      "Y": 3050.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [
      {
        "current_kVA": 151.64,
        "loading_percent": 50.55,
        "name": "xfmr_neigh_14",
        "rated_kVA": 300.0,
        "status": "OK"
      }
    ],
    "VAngle": -10.013413479612142,
    "VMag_pu": 0.7726757394377756
  },
  {
    "Bus": "300",

```

```

    "Coordinates": {
      "X": 3245.0,
      "Y": 4010.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -10.01341579629641,
    "VMag_pu": 0.7726757919124402
  },
  {
    "Bus": "109",
    "Coordinates": {
      "X": 3975.0,
      "Y": 3050.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -10.01342500715824,
    "VMag_pu": 0.7726758970354485
  },
  {
    "Bus": "110",
    "Coordinates": {
      "X": 4275.0,
      "Y": 3050.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,

```

```
"Net_Power_kW": 0.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -10.01343130332637,
"VMag_pu": 0.7726759831129055
},
{
  "Bus": "112",
  "Coordinates": {
    "X": 4275.0,
    "Y": 2925.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -10.013432711476598,
  "VMag_pu": 0.772676002364299
},
{
  "Bus": "113",
  "Coordinates": {
    "X": 4800.0,
    "Y": 2925.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -10.013436519268971,
  "VMag_pu": 0.7726760544221788
},
{
  "Bus": "114",
```

```

    "Coordinates": {
      "X": 5125.0,
      "Y": 2925.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 20.0,
    "Net_Power_kW": -20.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -10.013437171261746,
    "VMag_pu": 0.7726760633358385
  },
  {
    "Bus": "111",
    "Coordinates": {
      "X": 4275.0,
      "Y": 3625.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 20.0,
    "Net_Power_kW": -20.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -10.013433344179546,
    "VMag_pu": 0.7726760110142403
  },
  {
    "Bus": "106",
    "Coordinates": {
      "X": 3750.0,
      "Y": 2725.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,

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    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -123.62654801330089,
    "VMag_pu": 1.1382181519945196
  },
  {
    "Bus": "107",
    "Coordinates": {
      "X": 4325.0,
      "Y": 2725.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -123.62655005415408,
    "VMag_pu": 1.1382181930955846
  },
  {
    "Bus": "102",
    "Coordinates": {
      "X": 3750.0,
      "Y": 2450.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 20.0,
    "Net_Power_kW": -20.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": 125.47517711719246,
    "VMag_pu": 1.0622044751302544
  },
  {
    "Bus": "103",

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    "Coordinates": {
      "X": 4075.0,
      "Y": 2450.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": 125.47517365661507,
    "VMag_pu": 1.0622045401690468
  },
  {
    "Bus": "104",
    "Coordinates": {
      "X": 4775.0,
      "Y": 2450.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": 125.47517063198573,
    "VMag_pu": 1.06220459701455
  },
  {
    "Bus": "98",
    "Coordinates": {
      "X": 3800.0,
      "Y": 2100.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,

```

```

    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -9.640737342007348,
    "VMag_pu": 0.7793059497750535
  },
  {
    "Bus": "99",
    "Coordinates": {
      "X": 4350.0,
      "Y": 2100.0
    },
    "DFPs": [],
    "Devices": [],
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    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -9.640740830146779,
    "VMag_pu": 0.7793060301333362
  },
  {
    "Bus": "100",
    "Coordinates": {
      "X": 4650.0,
      "Y": 2100.0
    },
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    "Devices": [],
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    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -9.640742144685131,
    "VMag_pu": 0.7793060604171196
  },
  {
    "Bus": "450",

```



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    "Coordinates": {
      "X": 5450.0,
      "Y": 2100.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -9.640743620657963,
    "VMag_pu": 0.7793060944199651
  },
  {
    "Bus": "72",
    "Coordinates": {
      "X": 3525.0,
      "Y": 1575.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -9.774424126042941,
    "VMag_pu": 0.777463425659136
  },
  {
    "Bus": "76",
    "Coordinates": {
      "X": 3525.0,
      "Y": 1375.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 221.24833310799792,

```

```
"Net_Power_kW": -221.24833310799792,
"StorageDevices": [],
"Transformers": [
  {
    "current_kVA": 298.69,
    "loading_percent": 99.56,
    "name": "xfmr_neigh_11",
    "rated_kVA": 300.0,
    "status": "OK"
  }
],
"VAngle": -9.99547663540569,
"VMag_pu": 0.7739647326686381
},
{
  "Bus": "86",
  "Coordinates": {
    "X": 3255.0,
    "Y": 725.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [
    {
      "current_kVA": 151.68,
      "loading_percent": 50.56,
      "name": "xfmr_neigh_10",
      "rated_kVA": 300.0,
      "status": "OK"
    }
  ],
  "VAngle": -10.301869113873842,
  "VMag_pu": 0.7693432882131651
},
{
  "Bus": "87",
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"Coordinates": {
  "X": 3050.0,
  "Y": 1125.0
},
"DFPs": [],
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"Net_Power_kW": -40.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -10.343510963079842,
"VMag_pu": 0.7690175968991292
},
{
  "Bus": "89",
  "Coordinates": {
    "X": 2775.0,
    "Y": 1125.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -10.357129730289628,
  "VMag_pu": 0.7684444316580854
},
{
  "Bus": "91",
  "Coordinates": {
    "X": 2550.0,
    "Y": 1125.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
```

```
"Net_Power_kW": 0.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -10.359081026297284,
"VMag_pu": 0.768100339804461
},
{
  "Bus": "93",
  "Coordinates": {
    "X": 2325.0,
    "Y": 1125.0
  },
  "DFPs": [],
  "Devices": [],
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  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -10.374604078097825,
  "VMag_pu": 0.7678559882347614
},
{
  "Bus": "95",
  "Coordinates": {
    "X": 2025.0,
    "Y": 1125.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -10.374604556406764,
  "VMag_pu": 0.7678559891418099
},
{
  "Bus": "96",
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"Coordinates": {
  "X": 2025.0,
  "Y": 925.0
},
"DFPs": [],
"Devices": [],
"Gen_kW": 0,
"Load_kW": 20.0,
"Net_Power_kW": -20.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -123.9311152071907,
"VMag_pu": 1.1465106164465835
},
{
  "Bus": "94",
  "Coordinates": {
    "X": 2325.0,
    "Y": 850.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -10.389870471920352,
  "VMag_pu": 0.7672559112788829
},
{
  "Bus": "92",
  "Coordinates": {
    "X": 2550.0,
    "Y": 825.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
```

```
"Net_Power_kW": -40.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": 125.64927516077265,
"VMag_pu": 1.0689546564915646
},
{
  "Bus": "90",
  "Coordinates": {
    "X": 2775.0,
    "Y": 900.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -123.95088066377355,
  "VMag_pu": 1.1470551802909472
},
{
  "Bus": "88",
  "Coordinates": {
    "X": 2950.0,
    "Y": 1300.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -10.365394269307538,
  "VMag_pu": 0.7693152998898821
},
{
  "Bus": "77",
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"Coordinates": {
  "X": 3925.0,
  "Y": 1375.0
},
"DFPs": [],
"Devices": [],
"Gen_kW": 0,
"Load_kW": 34.73449228777606,
"Net_Power_kW": -34.73449228777606,
"StorageDevices": [],
"Transformers": [],
"VAngle": -10.032896025847702,
"VMag_pu": 0.7745619408379205
},
{
  "Bus": "78",
  "Coordinates": {
    "X": 4025.0,
    "Y": 1375.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -10.04224172770219,
  "VMag_pu": 0.7747112920909954
},
{
  "Bus": "80",
  "Coordinates": {
    "X": 4025.0,
    "Y": 900.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 34.73449228777606,
```

```
"Net_Power_kW": -34.73449228777606,
"StorageDevices": [],
"Transformers": [],
"VAngle": -10.086583370068281,
"VMag_pu": 0.7754209687192397
},
{
  "Bus": "81",
  "Coordinates": {
    "X": 4025.0,
    "Y": 425.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -10.102899011847798,
  "VMag_pu": 0.7756825400839332
},
{
  "Bus": "84",
  "Coordinates": {
    "X": 4700.0,
    "Y": 425.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 17.36724614388803,
  "Net_Power_kW": -17.36724614388803,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": 125.47417048881606,
  "VMag_pu": 1.071430965191369
},
{
  "Bus": "85",
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```
"Coordinates": {
  "X": 4700.0,
  "Y": 900.0
},
"DFPs": [],
"Devices": [],
"Gen_kW": 0,
"Load_kW": 34.73449228777606,
"Net_Power_kW": -34.73449228777606,
"StorageDevices": [],
"Transformers": [],
"VAngle": 125.47416909609775,
"VMag_pu": 1.0714309915937614
},
{
  "Bus": "82",
  "Coordinates": {
    "X": 4025.0,
    "Y": 175.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 34.73449228777606,
  "Net_Power_kW": -34.73449228777606,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -10.126189418105477,
  "VMag_pu": 0.776056329916167
},
{
  "Bus": "83",
  "Coordinates": {
    "X": 4275.0,
    "Y": 175.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 17.36724614388803,
```

```
"Net_Power_kW": -17.36724614388803,
"StorageDevices": [],
"Transformers": [],
"VAngle": -10.149457070219965,
"VMag_pu": 0.776430241956416
},
{
  "Bus": "79",
  "Coordinates": {
    "X": 4250.0,
    "Y": 1375.0
  },
  "DFPs": [],
  "Devices": [],
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  "Load_kW": 34.73449228777606,
  "Net_Power_kW": -34.73449228777606,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -10.042241859583125,
  "VMag_pu": 0.7747112944804797
},
{
  "Bus": "73",
  "Coordinates": {
    "X": 3800.0,
    "Y": 1575.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": 125.44778444519464,
  "VMag_pu": 1.0641100217911676
},
{
  "Bus": "74",
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"Coordinates": {
  "X": 4150.0,
  "Y": 1575.0
},
"DFPs": [],
"Devices": [],
"Gen_kW": 0,
"Load_kW": 40.0,
"Net_Power_kW": -40.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": 125.44778196067766,
"VMag_pu": 1.0641100685694524
},
{
  "Bus": "75",
  "Coordinates": {
    "X": 4550.0,
    "Y": 1575.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": 125.44778097304362,
  "VMag_pu": 1.064110087164548
},
{
  "Bus": "68",
  "Coordinates": {
    "X": 3725.0,
    "Y": 1850.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
```

```

    "Net_Power_kW": -20.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -9.473715606198292,
    "VMag_pu": 0.7822928587536297
  },
  {
    "Bus": "69",
    "Coordinates": {
      "X": 4000.0,
      "Y": 1850.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -9.473718110005063,
    "VMag_pu": 0.78229289341023
  },
  {
    "Bus": "70",
    "Coordinates": {
      "X": 4325.0,
      "Y": 1850.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 20.0,
    "Net_Power_kW": -20.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -9.473719865370281,
    "VMag_pu": 0.782292917707231
  },
  {
    "Bus": "71",

```

```
"Coordinates": {
  "X": 4600.0,
  "Y": 1850.0
},
"DFPs": [],
"Devices": [],
"Gen_kW": 0,
"Load_kW": 40.0,
"Net_Power_kW": -40.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -9.473720332181678,
"VMag_pu": 0.7822929241686313
},
{
  "Bus": "62",
  "Coordinates": {
    "X": 3075.0,
    "Y": 2100.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -8.731641437242208,
  "VMag_pu": 0.7954856395544726
},
{
  "Bus": "63",
  "Coordinates": {
    "X": 3075.0,
    "Y": 2275.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
```

```
"Net_Power_kW": -40.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -8.731668164362045,
"VMag_pu": 0.7954857178138837
},
{
  "Bus": "64",
  "Coordinates": {
    "X": 3075.0,
    "Y": 2625.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 75.0,
  "Net_Power_kW": -75.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -8.731709802387885,
  "VMag_pu": 0.7954858397340127
},
{
  "Bus": "65",
  "Coordinates": {
    "X": 2650.0,
    "Y": 2625.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 140.0,
  "Net_Power_kW": -140.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -8.731739182104802,
  "VMag_pu": 0.7954859257608219
},
{
  "Bus": "66",
```

```

    "Coordinates": {
      "X": 2650.0,
      "Y": 2300.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 75.0,
    "Net_Power_kW": -75.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -8.731745974404909,
    "VMag_pu": 0.7954859456493943
  },
  {
    "Bus": "61",
    "Coordinates": {
      "X": 3075.0,
      "Y": 1300.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -8.731597132207312,
    "VMag_pu": 0.7954855253739812
  },
  {
    "Bus": "61s",
    "Coordinates": {
      "X": 3175.0,
      "Y": 1300.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,

```

```
"Net_Power_kW": 0.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -8.73159713188071,
"VMag_pu": 0.7954855253689306
},
{
  "Bus": "58",
  "Coordinates": {
    "X": 2075.0,
    "Y": 1850.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -122.67613012810763,
  "VMag_pu": 1.0941789071243988
},
{
  "Bus": "59",
  "Coordinates": {
    "X": 1825.0,
    "Y": 1850.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -122.67613051390217,
  "VMag_pu": 1.0941789145933603
},
{
  "Bus": "55",
```



```
"Coordinates": {
  "X": 2600.0,
  "Y": 1500.0
},
"DFPs": [],
"Devices": [],
"Gen_kW": 0,
"Load_kW": 20.0,
"Net_Power_kW": -20.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -6.076693383564685,
"VMag_pu": 0.8489254338243376
},
{
  "Bus": "56",
  "Coordinates": {
    "X": 2875.0,
    "Y": 1500.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -6.076693537475085,
  "VMag_pu": 0.8489254389334803
},
{
  "Bus": "18",
  "Coordinates": {
    "X": 1500.0,
    "Y": 2325.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
```

```
"Net_Power_kW": 0.0,
"StorageDevices": [],
"Transformers": [
  {
    "current_kVA": 139.28,
    "loading_percent": 46.43,
    "name": "xfmr_neigh_5",
    "rated_kVA": 300.0,
    "status": "OK"
  }
],
"VAngle": -5.271718931828803,
"VMag_pu": 0.8656164984356396
},
{
  "Bus": "135",
  "Coordinates": {
    "X": 1600.0,
    "Y": 2325.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -5.273172410700282,
  "VMag_pu": 0.8654987426220531
},
{
  "Bus": "35",
  "Coordinates": {
    "X": 1975.0,
    "Y": 2325.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
```

```
"Net_Power_kW": -40.0,
"StorageDevices": [],
"Transformers": [
  {
    "current_kVA": 120.62,
    "loading_percent": 40.21,
    "name": "xfmr_neigh_7",
    "rated_kVA": 300.0,
    "status": "OK"
  }
],
"VAngle": -5.520760926992981,
"VMag_pu": 0.8595935960253333
},
{
  "Bus": "40",
  "Coordinates": {
    "X": 1975.0,
    "Y": 2575.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -5.634281551587305,
  "VMag_pu": 0.8566970193801331
},
{
  "Bus": "42",
  "Coordinates": {
    "X": 1975.0,
    "Y": 2825.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 11.02453493247725,
```

```
"Net_Power_kW": -11.02453493247725,
"StorageDevices": [],
"Transformers": [
  {
    "current_kVA": 298.33,
    "loading_percent": 99.44,
    "name": "xfmr_neigh_8",
    "rated_kVA": 300.0,
    "status": "OK"
  }
],
"VAngle": -5.7485720757610554,
"VMag_pu": 0.8538038216850415
},
{
  "Bus": "44",
  "Coordinates": {
    "X": 1975.0,
    "Y": 3025.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -5.748575791083417,
  "VMag_pu": 0.8538038690221723
},
{
  "Bus": "47",
  "Coordinates": {
    "X": 1975.0,
    "Y": 3275.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 57.87880839550556,
```

```
"Net_Power_kW": -57.87880839550556,  
"StorageDevices": [],  
"Transformers": [],  
"VAngle": -5.748579674981743,  
"VMag_pu": 0.853803901881893  
},  
{  
  "Bus": "49",  
  "Coordinates": {  
    "X": 2225.0,  
    "Y": 3275.0  
  },  
  "DFPs": [],  
  "Devices": [],  
  "Gen_kW": 0,  
  "Load_kW": 88.7087482972748,  
  "Net_Power_kW": -88.7087482972748,  
  "StorageDevices": [],  
  "Transformers": [],  
  "VAngle": -5.748582309510821,  
  "VMag_pu": 0.8538039246127386  
},  
{  
  "Bus": "50",  
  "Coordinates": {  
    "X": 2475.0,  
    "Y": 3275.0  
  },  
  "DFPs": [],  
  "Devices": [],  
  "Gen_kW": 0,  
  "Load_kW": 22.0490698649545,  
  "Net_Power_kW": -22.0490698649545,  
  "StorageDevices": [],  
  "Transformers": [],  
  "VAngle": -5.748584358580017,  
  "VMag_pu": 0.8538039422922622  
},  
{  
  "Bus": "51",
```

```
"Coordinates": {
  "X": 2725.0,
  "Y": 3275.0
},
"DFPs": [],
"Devices": [],
"Gen_kW": 0,
"Load_kW": 11.02453493247725,
"Net_Power_kW": -11.02453493247725,
"StorageDevices": [],
"Transformers": [],
"VAngle": -5.748585822189356,
"VMag_pu": 0.8538039549204633
},
{
  "Bus": "151",
  "Coordinates": {
    "X": 3187.0,
    "Y": 3928.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -5.748586993028528,
  "VMag_pu": 0.8538039650228958
},
{
  "Bus": "300_open",
  "Coordinates": {
    "X": 0.0,
    "Y": 0.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
```

```

    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -5.748586993028528,
    "VMag_pu": 0.8538039650228958
  },
  {
    "Bus": "48",
    "Coordinates": {
      "X": 1825.0,
      "Y": 3275.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 115.75761679101112,
    "Net_Power_kW": -115.75761679101112,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -5.748579780364493,
    "VMag_pu": 0.8538039027911307
  },
  {
    "Bus": "45",
    "Coordinates": {
      "X": 2175.0,
      "Y": 3025.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 11.02453493247725,
    "Net_Power_kW": -11.02453493247725,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -5.748576778717463,
    "VMag_pu": 0.8538038839422117
  },
  {
    "Bus": "46",

```

```

    "Coordinates": {
      "X": 2475.0,
      "Y": 3025.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 11.02453493247725,
    "Net_Power_kW": -11.02453493247725,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -5.748577334261595,
    "VMag_pu": 0.853803892334734
  },
  {
    "Bus": "43",
    "Coordinates": {
      "X": 2475.0,
      "Y": 2825.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 22.0490698649545,
    "Net_Power_kW": -22.0490698649545,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -122.09173465117003,
    "VMag_pu": 1.0759967135814232
  },
  {
    "Bus": "41",
    "Coordinates": {
      "X": 2300.0,
      "Y": 2575.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 20.0,

```



```

    "Net_Power_kW": -20.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": 123.51879339367319,
    "VMag_pu": 1.0100780665254476
  },
  {
    "Bus": "36",
    "Coordinates": {
      "X": 2075.0,
      "Y": 2000.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -5.520764236559774,
    "VMag_pu": 0.8595936331316011
  },
  {
    "Bus": "38",
    "Coordinates": {
      "X": 2325.0,
      "Y": 2000.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 20.0,
    "Net_Power_kW": -20.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -122.01783135068618,
    "VMag_pu": 1.0733206012396987
  },
  {
    "Bus": "39",

```

```

    "Coordinates": {
      "X": 2650.0,
      "Y": 2000.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 20.0,
    "Net_Power_kW": -20.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -122.01783200267897,
    "VMag_pu": 1.0733206136216205
  },
  {
    "Bus": "37",
    "Coordinates": {
      "X": 1775.0,
      "Y": 2000.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -5.520764792103916,
    "VMag_pu": 0.8595936415810342
  },
  {
    "Bus": "21",
    "Coordinates": {
      "X": 1500.0,
      "Y": 2625.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,

```

```

    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -5.361370584254968,
    "VMag_pu": 0.8638281350398315
  },
  {
    "Bus": "23",
    "Coordinates": {
      "X": 1500.0,
      "Y": 2875.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -5.436363377419075,
    "VMag_pu": 0.8623394535763936
  },
  {
    "Bus": "25",
    "Coordinates": {
      "X": 1500.0,
      "Y": 3150.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -5.519155352659556,
    "VMag_pu": 0.8607036129889764
  },
  {
    "Bus": "25r",

```

```
"Coordinates": {
  "X": 1500.0,
  "Y": 3150.0
},
"DFPs": [],
"Devices": [],
"Gen_kW": 0,
"Load_kW": 0.0,
"Net_Power_kW": 0.0,
"StorageDevices": [],
"Transformers": [
  {
    "current_kVA": 170.8,
    "loading_percent": 56.93,
    "name": "xfmr_neigh_6",
    "rated_kVA": 300.0,
    "status": "OK"
  }
],
"VAngle": -5.5197345321503395,
"VMag_pu": 0.8606988400487777
},
{
  "Bus": "26",
  "Coordinates": {
    "X": 1150.0,
    "Y": 3150.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -5.519734863128009,
  "VMag_pu": 0.8606988858322605
},
{
  "Bus": "31",
```

```
"Coordinates": {
  "X": 1150.0,
  "Y": 3375.0
},
"DFPs": [],
"Devices": [],
"Gen_kW": 0,
"Load_kW": 20.0,
"Net_Power_kW": -20.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": 123.47061489253673,
"VMag_pu": 1.0094629779284672
},
{
  "Bus": "32",
  "Coordinates": {
    "X": 1150.0,
    "Y": 3675.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": 123.47061433699257,
  "VMag_pu": 1.009462987851051
},
{
  "Bus": "27",
  "Coordinates": {
    "X": 875.0,
    "Y": 3150.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
```

```

    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -5.519735538591433,
    "VMag_pu": 0.8606989120724994
  },
  {
    "Bus": "33",
    "Coordinates": {
      "X": 875.0,
      "Y": 3650.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -5.5197370817696285,
    "VMag_pu": 0.860698935573326
  },
  {
    "Bus": "28",
    "Coordinates": {
      "X": 1500.0,
      "Y": 3350.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -5.519156325105121,
    "VMag_pu": 0.8607036346725374
  },
  {
    "Bus": "29",

```

```
"Coordinates": {
  "X": 1500.0,
  "Y": 3650.0
},
"DFPs": [],
"Devices": [],
"Gen_kW": 0,
"Load_kW": 40.0,
"Net_Power_kW": -40.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -5.51915739991335,
"VMag_pu": 0.860703658638579
},
{
  "Bus": "30",
  "Coordinates": {
    "X": 1850.0,
    "Y": 3650.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -5.519158071668471,
  "VMag_pu": 0.8607036736173551
},
{
  "Bus": "250",
  "Coordinates": {
    "X": 2050.0,
    "Y": 3650.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
```

```

    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -5.5191581740311575,
    "VMag_pu": 0.8607036758998353
  },
  {
    "Bus": "24",
    "Coordinates": {
      "X": 950.0,
      "Y": 2875.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": 123.41740158532126,
    "VMag_pu": 1.0095460520345159
  },
  {
    "Bus": "22",
    "Coordinates": {
      "X": 975.0,
      "Y": 2625.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -121.96742298181061,
    "VMag_pu": 1.0717381183613162
  },
  {
    "Bus": "19",

```



```
"Coordinates": {
  "X": 1250.0,
  "Y": 2325.0
},
"DFPs": [],
"Devices": [],
"Gen_kW": 0,
"Load_kW": 40.0,
"Net_Power_kW": -40.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -5.271720320689183,
"VMag_pu": 0.8656165197072275
},
{
  "Bus": "20",
  "Coordinates": {
    "X": 925.0,
    "Y": 2325.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -5.271720972681951,
  "VMag_pu": 0.8656165296930567
},
{
  "Bus": "34",
  "Coordinates": {
    "X": 1500.0,
    "Y": 1350.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
```

```

    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": 122.62795300181936,
    "VMag_pu": 1.0102400227454194
  },
  {
    "Bus": "15",
    "Coordinates": {
      "X": 1500.0,
      "Y": 1250.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": 122.62795204504887,
    "VMag_pu": 1.010240039847468
  },
  {
    "Bus": "17",
    "Coordinates": {
      "X": 1850.0,
      "Y": 1250.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 20.0,
    "Net_Power_kW": -20.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": 122.62795128889157,
    "VMag_pu": 1.0102400533636036
  },
  {
    "Bus": "16",

```

```

    "Coordinates": {
      "X": 1500.0,
      "Y": 875.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": 122.62795117701116,
    "VMag_pu": 1.0102400553634396
  },
  {
    "Bus": "9",
    "Coordinates": {
      "X": 1200.0,
      "Y": 1725.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -3.22063181609293,
    "VMag_pu": 0.9135070683039987
  },
  {
    "Bus": "9r",
    "Coordinates": {
      "X": 1200.0,
      "Y": 1725.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,

```

```

    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -3.2206318161060183,
    "VMag_pu": 0.9135070685126381
  },
  {
    "Bus": "14",
    "Coordinates": {
      "X": 1200.0,
      "Y": 2150.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -3.220635554455347,
    "VMag_pu": 0.9135071289363754
  },
  {
    "Bus": "10",
    "Coordinates": {
      "X": 1450.0,
      "Y": 2150.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 20.0,
    "Net_Power_kW": -20.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -3.220635940249886,
    "VMag_pu": 0.9135071351720554
  },
  {
    "Bus": "11",

```

```
"Coordinates": {
  "X": 950.0,
  "Y": 2150.0
},
"DFPs": [],
"Devices": [],
"Gen_kW": 0,
"Load_kW": 40.0,
"Net_Power_kW": -40.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -3.220635940249886,
"VMag_pu": 0.9135071351720554
},
{
  "Bus": "12",
  "Coordinates": {
    "X": 1200.0,
    "Y": 1275.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -121.31223342925213,
  "VMag_pu": 1.0469355412107475
},
{
  "Bus": "3",
  "Coordinates": {
    "X": 700.0,
    "Y": 1250.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
```

```
"Net_Power_kW": 0.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": 120.9319403741633,
"VMag_pu": 1.0031027505000747
},
{
  "Bus": "5",
  "Coordinates": {
    "X": 1025.0,
    "Y": 1250.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": 120.9319387191047,
  "VMag_pu": 1.0031027798748533
},
{
  "Bus": "6",
  "Coordinates": {
    "X": 1275.0,
    "Y": 1150.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": 120.93193833331016,
  "VMag_pu": 1.0031027867221212
},
{
  "Bus": "4",
```

```

    "Coordinates": {
      "X": 700.0,
      "Y": 1050.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": 120.9319401272548,
    "VMag_pu": 1.003102754882326
  },
  {
    "Bus": "2",
    "Coordinates": {
      "X": 700.0,
      "Y": 1675.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 20.0,
    "Net_Power_kW": -20.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -120.61231672188734,
    "VMag_pu": 1.0215717617261029
  },
  {
    "Bus": "610",
    "Coordinates": {
      "X": 3275.0,
      "Y": 1300.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,

```

```

    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -3.157499911245789,
    "VMag_pu": 0.9255647654223887
  },
  {
    "Bus": "150r",
    "Coordinates": {
      "X": 100.0,
      "Y": 1500.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -0.003211468321421869,
    "VMag_pu": 0.9999607103977791
  }
],
"management_status": {
  "management_log": [
    "System stabilized in 1 iteration(s)."
  ],
  "status": "OK"
},
"power_summary": {
  "circuit_loading_percent": -11.24,
  "converged": true,
  "maximum_circuit_load_kW": 3490.0,
  "maximum_circuit_power_kVA": 21350.0,
  "total_circuit_power_kW": -2400.4,
  "total_gen_kW": 0,
  "total_load_kW": 3170.2,
  "total_losses_kW": 261.2745
},
"voltage_profile": {

```



```

        "avg_voltage_pu": 0.8863,
        "max_voltage_pu": 1.1471,
        "min_voltage_pu": 0.7673
    }
},
"status": "success"
}

```

## API 18: add new node

### Parameters:

```

"bus_name": "901",
"neighborhood_id": 7,
"coordinates": {
    "x": 2400.0,
    "y": 1150.0
},
"load_kw": 100.0,
"load_kvar": 30.0,
"connections": [
    {
        "to_bus": "39",
        "linecode": "1",
        "length": 0.2
    },
    {
        "to_bus": "40",
        "linecode": "1",
        "length": 0.25
    }
]

```

### Description:

This API adds a node to an existing simulation. It takes in the initial parameters of the bus's variables as well as the other buses that it's connected to. This allows it to be correctly simulated because variation in a new node's loads will affect its neighbors and vice versa. It is also added to the correct neighborhood so that the corresponding transformer gets accurately modified throughout the simulation.

### Response:

```

{

```

```

    "message": "Successfully added physical node '903' with 3 connections.",
    "status": "success"
}

```

## API 19: save cache

### Parameters:

```
"filename": "my_session_july10"
```

### Description:

Since our API is a wrapper around an existing simulation model, it does not affect the original files in the OpenDSS Simulation. Instead, all changes are done in cache and will not be saved between sessions. Since we want changes such as adding new buses, or adding devices to be saved, this API will store all bus, transformer, and DFP data locally under a given name.

### Response:

```

{
  "message": "Successfully saved circuit state to 'my_session_july10.cache'",
  "path": "c:\\Users\\tarun\\BITS\\Eco Yr 2 CDCs\\PS-1\\opendss_testing -
Copy\\cache\\my_session_july10.cache",
  "status": "success"
}

```

## API 20: load cache

### Parameters:

```
"filename": "my_session_july10"
```

### Description:

This loads a saved cache and ensures that the simulation runs on this stored data. It will throw an error if the given name is not found.

### Response:

```

{
  "message": "Successfully loaded circuit state from 'my_session_july10.cache'",
  "results": {
    "bus_details": [
      {
        "Bus": "150",
        "Coordinates": {
          "X": 100.0,
          "Y": 1500.0
        }
      }
    ]
  }
}

```

```

    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -0.002695299066859189,
    "VMag_pu": 0.9999668891450174
  },
  {
    "Bus": "149",
    "Coordinates": {
      "X": 300.0,
      "Y": 1500.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -0.011611856613387199,
    "VMag_pu": 0.999153759448558
  },
  {
    "Bus": "1",
    "Coordinates": {
      "X": 700.0,
      "Y": 1500.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 80.0,
    "Net_Power_kW": -80.0,
    "StorageDevices": [
      {

```

```
        "actual_charge_rate": 40.0,
        "actual_discharge_rate": 0,
        "build_charge_rate": 40.0,
        "build_discharge_rate": 2.0,
        "current_energy_kwh": 0.64,
        "device_name": "mybattery",
        "max_capacity_kwh": 20.0,
        "mode": "load"
    }
],
"Transformers": [
    {
        "current_kVA": 193.14,
        "loading_percent": 64.38,
        "name": "xfmr_neigh_1",
        "rated_kVA": 300.0,
        "status": "OK"
    }
],
"VAngle": -1.6175411144429042,
"VMag_pu": 0.9542309931514217
},
{
    "Bus": "7",
    "Coordinates": {
        "X": 1000.0,
        "Y": 1500.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 20.0,
    "Net_Power_kW": -20.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -2.83128205723776,
    "VMag_pu": 0.9228680575761291
},
{
    "Bus": "8",
```

```
"Coordinates": {
  "X": 1200.0,
  "Y": 1500.0
},
"DFPs": [],
"Devices": [],
"Gen_kW": 0,
"Load_kW": 0.0,
"Net_Power_kW": 0.0,
"StorageDevices": [],
"Transformers": [
  {
    "current_kVA": 113.97,
    "loading_percent": 37.99,
    "name": "xfmr_neigh_2",
    "rated_kVA": 300.0,
    "status": "OK"
  }
],
"VAngle": -3.687072938300882,
"VMag_pu": 0.902202795450564
},
{
  "Bus": "13",
  "Coordinates": {
    "X": 1500.0,
    "Y": 1500.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [
    {
      "current_kVA": 161.14,
      "loading_percent": 53.71,
      "name": "xfmr_neigh_3",
      "rated_kVA": 300.0,
```

```
        "status": "OK"
      }
    ],
    "VAngle": -4.984200942406389,
    "VMag_pu": 0.8727130538062857
  },
  {
    "Bus": "152",
    "Coordinates": {
      "X": 1600.0,
      "Y": 1500.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -4.990371659174367,
    "VMag_pu": 0.8723412689582835
  },
  {
    "Bus": "52",
    "Coordinates": {
      "X": 2000.0,
      "Y": 1500.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -5.944377056911603,
    "VMag_pu": 0.8510787768640611
  },
  {
    "Bus": "53",
```

```
"Coordinates": {
  "X": 2200.0,
  "Y": 1500.0
},
"DFPs": [],
"Devices": [],
"Gen_kW": 0,
"Load_kW": 40.0,
"Net_Power_kW": -40.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -6.4394102507048405,
"VMag_pu": 0.8405393557986354
},
{
  "Bus": "54",
  "Coordinates": {
    "X": 2325.0,
    "Y": 1500.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [
    {
      "current_kVA": 65.1,
      "loading_percent": 21.7,
      "name": "xfmr_neigh_4",
      "rated_kVA": 300.0,
      "status": "OK"
    }
  ],
  "VAngle": -6.7551452159278496,
  "VMag_pu": 0.8339847312992892
},
{
  "Bus": "94_open",
```

```

    "Coordinates": {
      "X": 0.0,
      "Y": 0.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -6.7551452159278496,
    "VMag_pu": 0.8339847312992892
  },
  {
    "Bus": "57",
    "Coordinates": {
      "X": 2325.0,
      "Y": 1850.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -7.571003643049668,
    "VMag_pu": 0.8167256049542677
  },
  {
    "Bus": "60",
    "Coordinates": {
      "X": 3075.0,
      "Y": 1850.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 20.0,

```



```

    "Net_Power_kW": -20.0,
    "StorageDevices": [],
    "Transformers": [
      {
        "current_kVA": 267.87,
        "loading_percent": 89.29,
        "name": "xfmr_neigh_9",
        "rated_kVA": 300.0,
        "status": "OK"
      }
    ],
    "VAngle": -9.43972675061116,
    "VMag_pu": 0.7803379211194
  },
  {
    "Bus": "160",
    "Coordinates": {
      "X": 3175.0,
      "Y": 1850.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -9.44698119154602,
    "VMag_pu": 0.7800748865900186
  },
  {
    "Bus": "160r",
    "Coordinates": {
      "X": 3175.0,
      "Y": 1850.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,

```

```
"Net_Power_kW": 0.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -9.450812903385936,
"VMag_pu": 0.7800511480736279
},
{
  "Bus": "67",
  "Coordinates": {
    "X": 3525.0,
    "Y": 1850.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [
    {
      "current_kVA": 163.14,
      "loading_percent": 54.38,
      "name": "xfmr_neigh_12",
      "rated_kVA": 300.0,
      "status": "OK"
    }
  ],
  "VAngle": -10.194405406207546,
  "VMag_pu": 0.7669966094904869
},
{
  "Bus": "97",
  "Coordinates": {
    "X": 3525.0,
    "Y": 2100.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
```

```
"Net_Power_kW": 0.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -10.361087156194134,
"VMag_pu": 0.7640746550324471
},
{
  "Bus": "197",
  "Coordinates": {
    "X": 3525.0,
    "Y": 2200.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -10.363020379232106,
  "VMag_pu": 0.7639837049526356
},
{
  "Bus": "101",
  "Coordinates": {
    "X": 3525.0,
    "Y": 2450.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [
    {
      "current_kVA": 147.34,
      "loading_percent": 49.11,
      "name": "xfmr_neigh_13",
      "rated_kVA": 300.0,
```

```
        "status": "OK"
      }
    ],
    "VAngle": -10.531005369373046,
    "VMag_pu": 0.7610682863122081
  },
  {
    "Bus": "105",
    "Coordinates": {
      "X": 3525.0,
      "Y": 2725.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -10.623361459560767,
    "VMag_pu": 0.7594721953652369
  },
  {
    "Bus": "108",
    "Coordinates": {
      "X": 3525.0,
      "Y": 3050.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [
      {
        "current_kVA": 145.46,
        "loading_percent": 48.49,
        "name": "xfmr_neigh_14",
        "rated_kVA": 300.0,
```

```
        "status": "OK"
      }
    ],
    "VAngle": -10.733009406623259,
    "VMag_pu": 0.7575884659896629
  },
  {
    "Bus": "300",
    "Coordinates": {
      "X": 3245.0,
      "Y": 4010.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -10.733011744577556,
    "VMag_pu": 0.7575885169558039
  },
  {
    "Bus": "109",
    "Coordinates": {
      "X": 3975.0,
      "Y": 3050.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -10.733020934169359,
    "VMag_pu": 0.7575886205100825
  },
  {
    "Bus": "110",
```

```

    "Coordinates": {
      "X": 4275.0,
      "Y": 3050.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -10.73302723033748,
    "VMag_pu": 0.7575887049067905
  },
  {
    "Bus": "112",
    "Coordinates": {
      "X": 4275.0,
      "Y": 2925.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 20.0,
    "Net_Power_kW": -20.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -10.733028638487713,
    "VMag_pu": 0.757588723782281
  },
  {
    "Bus": "113",
    "Coordinates": {
      "X": 4800.0,
      "Y": 2925.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,

```

```

    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -10.733032446280083,
    "VMag_pu": 0.7575887748236781
  },
  {
    "Bus": "114",
    "Coordinates": {
      "X": 5125.0,
      "Y": 2925.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 20.0,
    "Net_Power_kW": -20.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -10.733033098272857,
    "VMag_pu": 0.7575887835632895
  },
  {
    "Bus": "111",
    "Coordinates": {
      "X": 4275.0,
      "Y": 3625.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 20.0,
    "Net_Power_kW": -20.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -10.733029271190658,
    "VMag_pu": 0.7575887322633235
  },
  {
    "Bus": "106",

```

```
"Coordinates": {
  "X": 3750.0,
  "Y": 2725.0
},
"DFPs": [],
"Devices": [],
"Gen_kW": 0,
"Load_kW": 40.0,
"Net_Power_kW": -40.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -123.82358547034096,
"VMag_pu": 1.1455637733547468
},
{
  "Bus": "107",
  "Coordinates": {
    "X": 4325.0,
    "Y": 2725.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -123.82358751119412,
  "VMag_pu": 1.1455638147210625
},
{
  "Bus": "102",
  "Coordinates": {
    "X": 3750.0,
    "Y": 2450.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
```



```
"Net_Power_kW": -20.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": 125.83285179570409,
"VMag_pu": 1.063800363952872
},
{
  "Bus": "103",
  "Coordinates": {
    "X": 4075.0,
    "Y": 2450.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": 125.83284833512671,
  "VMag_pu": 1.0638004290893808
},
{
  "Bus": "104",
  "Coordinates": {
    "X": 4775.0,
    "Y": 2450.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": 125.83284531049738,
  "VMag_pu": 1.0638004860202903
},
{
  "Bus": "98",
```

```
"Coordinates": {
  "X": 3800.0,
  "Y": 2100.0
},
"DFPs": [],
"Devices": [],
"Gen_kW": 0,
"Load_kW": 40.0,
"Net_Power_kW": -40.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -10.361089444007142,
"VMag_pu": 0.7640747057664984
},
{
  "Bus": "99",
  "Coordinates": {
    "X": 4350.0,
    "Y": 2100.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -10.36109296371914,
  "VMag_pu": 0.7640747838188892
},
{
  "Bus": "100",
  "Coordinates": {
    "X": 4650.0,
    "Y": 2100.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
```

```

    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -10.361094290155913,
    "VMag_pu": 0.7640748132336754
  },
  {
    "Bus": "450",
    "Coordinates": {
      "X": 5450.0,
      "Y": 2100.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -10.361095779488382,
    "VMag_pu": 0.7640748462608045
  },
  {
    "Bus": "72",
    "Coordinates": {
      "X": 3525.0,
      "Y": 1575.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -10.505950178878031,
    "VMag_pu": 0.7619461665256886
  },
  {
    "Bus": "76",

```

```
"Coordinates": {
  "X": 3525.0,
  "Y": 1375.0
},
"DFPs": [],
"Devices": [],
"Gen_kW": 0,
"Load_kW": 194.57266202376533,
"Net_Power_kW": -194.57266202376533,
"StorageDevices": [],
"Transformers": [
  {
    "current_kVA": 309.17,
    "loading_percent": 103.06,
    "name": "xfmr_neigh_11",
    "rated_kVA": 300.0,
    "status": "Overloaded"
  }
],
"VAngle": -10.73513086566717,
"VMag_pu": 0.7582874315946846
},
{
  "Bus": "86",
  "Coordinates": {
    "X": 3255.0,
    "Y": 725.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [
    {
      "current_kVA": 145.22,
      "loading_percent": 48.41,
      "name": "xfmr_neigh_10",
      "rated_kVA": 300.0,
```

```
        "status": "OK"
      }
    ],
    "VAngle": -11.041377484013228,
    "VMag_pu": 0.7537509903860127
  },
  {
    "Bus": "87",
    "Coordinates": {
      "X": 3050.0,
      "Y": 1125.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -11.0833013847368,
    "VMag_pu": 0.7534175276318359
  },
  {
    "Bus": "89",
    "Coordinates": {
      "X": 2775.0,
      "Y": 1125.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -11.097093361735663,
    "VMag_pu": 0.752847205013306
  },
  {
    "Bus": "91",
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"Coordinates": {
  "X": 2550.0,
  "Y": 1125.0
},
"DFPs": [],
"Devices": [],
"Gen_kW": 0,
"Load_kW": 0.0,
"Net_Power_kW": 0.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -11.098845478450087,
"VMag_pu": 0.7525050916394326
},
{
  "Bus": "93",
  "Coordinates": {
    "X": 2325.0,
    "Y": 1125.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -11.114324354514288,
  "VMag_pu": 0.7522663830808111
},
{
  "Bus": "95",
  "Coordinates": {
    "X": 2025.0,
    "Y": 1125.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
```

```

    "Net_Power_kW": -20.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -11.114324844899564,
    "VMag_pu": 0.7522663838627393
  },
  {
    "Bus": "96",
    "Coordinates": {
      "X": 2025.0,
      "Y": 925.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 20.0,
    "Net_Power_kW": -20.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -124.13591100588195,
    "VMag_pu": 1.1540178321772414
  },
  {
    "Bus": "94",
    "Coordinates": {
      "X": 2325.0,
      "Y": 850.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -11.12954725787136,
    "VMag_pu": 0.7516801640122939
  },
  {
    "Bus": "92",

```

```

    "Coordinates": {
      "X": 2550.0,
      "Y": 825.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": 126.01536413439253,
    "VMag_pu": 1.0707549495629691
  },
  {
    "Bus": "90",
    "Coordinates": {
      "X": 2775.0,
      "Y": 900.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -124.15569838603889,
    "VMag_pu": 1.1545710329077943
  },
  {
    "Bus": "88",
    "Coordinates": {
      "X": 2950.0,
      "Y": 1300.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,

```



```

    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -11.105184690964492,
    "VMag_pu": 0.7537091915055445
  },
  {
    "Bus": "77",
    "Coordinates": {
      "X": 3925.0,
      "Y": 1375.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 29.00940919955011,
    "Net_Power_kW": -29.00940919955011,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -10.77383433925555,
    "VMag_pu": 0.75881498918184
  },
  {
    "Bus": "78",
    "Coordinates": {
      "X": 4025.0,
      "Y": 1375.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -10.783501667045547,
    "VMag_pu": 0.758946930348495
  },
  {
    "Bus": "80",

```

```
"Coordinates": {
  "X": 4025.0,
  "Y": 900.0
},
"DFPs": [],
"Devices": [],
"Gen_kW": 0,
"Load_kW": 29.00940919955011,
"Net_Power_kW": -29.00940919955011,
"StorageDevices": [],
"Transformers": [],
"VAngle": -10.829374313830888,
"VMag_pu": 0.7595739233973995
},
{
  "Bus": "81",
  "Coordinates": {
    "X": 4025.0,
    "Y": 425.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -10.846255373964391,
  "VMag_pu": 0.7598050382349117
},
{
  "Bus": "84",
  "Coordinates": {
    "X": 4700.0,
    "Y": 425.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 14.504704599775055,
```

```
"Net_Power_kW": -14.504704599775055,
"StorageDevices": [],
"Transformers": [],
"VAngle": 125.84870232300355,
"VMag_pu": 1.0732377333355536
},
{
  "Bus": "85",
  "Coordinates": {
    "X": 4700.0,
    "Y": 900.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 29.00940919955011,
  "Net_Power_kW": -29.00940919955011,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": 125.84870093028525,
  "VMag_pu": 1.073237759782469
},
{
  "Bus": "82",
  "Coordinates": {
    "X": 4025.0,
    "Y": 175.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 29.00940919955011,
  "Net_Power_kW": -29.00940919955011,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -10.870354808727328,
  "VMag_pu": 0.760135324682148
},
{
  "Bus": "83",
```

```

    "Coordinates": {
      "X": 4275.0,
      "Y": 175.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 14.504704599775055,
    "Net_Power_kW": -14.504704599775055,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -10.894432975845469,
    "VMag_pu": 0.7604657397818295
  },
  {
    "Bus": "79",
    "Coordinates": {
      "X": 4250.0,
      "Y": 1375.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 29.00940919955011,
    "Net_Power_kW": -29.00940919955011,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -10.783501800641194,
    "VMag_pu": 0.7589469326614587
  },
  {
    "Bus": "73",
    "Coordinates": {
      "X": 3800.0,
      "Y": 1575.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,

```

```

    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": 125.81365758211778,
    "VMag_pu": 1.0657581544363388
  },
  {
    "Bus": "74",
    "Coordinates": {
      "X": 4150.0,
      "Y": 1575.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": 125.81365509760083,
    "VMag_pu": 1.0657582012870754
  },
  {
    "Bus": "75",
    "Coordinates": {
      "X": 4550.0,
      "Y": 1575.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": 125.81365410996679,
    "VMag_pu": 1.0657582199109716
  },
  {
    "Bus": "68",

```

```

    "Coordinates": {
      "X": 3725.0,
      "Y": 1850.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 20.0,
    "Net_Power_kW": -20.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -10.194407813565793,
    "VMag_pu": 0.7669966421605466
  },
  {
    "Bus": "69",
    "Coordinates": {
      "X": 4000.0,
      "Y": 1850.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -10.194410317372565,
    "VMag_pu": 0.7669966761395045
  },
  {
    "Bus": "70",
    "Coordinates": {
      "X": 4325.0,
      "Y": 1850.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 20.0,

```

```

    "Net_Power_kW": -20.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -10.194412072737784,
    "VMag_pu": 0.7669966999614247
  },
  {
    "Bus": "71",
    "Coordinates": {
      "X": 4600.0,
      "Y": 1850.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -10.194412539549175,
    "VMag_pu": 0.766996706296485
  },
  {
    "Bus": "62",
    "Coordinates": {
      "X": 3075.0,
      "Y": 2100.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -9.43977131335276,
    "VMag_pu": 0.780338032179378
  },
  {
    "Bus": "63",

```

```

    "Coordinates": {
      "X": 3075.0,
      "Y": 2275.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -9.439797772472224,
    "VMag_pu": 0.7803380981213877
  },
  {
    "Bus": "64",
    "Coordinates": {
      "X": 3075.0,
      "Y": 2625.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 75.0,
    "Net_Power_kW": -75.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -9.439838992981961,
    "VMag_pu": 0.7803382008522894
  },
  {
    "Bus": "65",
    "Coordinates": {
      "X": 2650.0,
      "Y": 2625.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 140.0,

```



```

    "Net_Power_kW": -140.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -9.4398680781004,
    "VMag_pu": 0.7803382733391999
  },
  {
    "Bus": "66",
    "Coordinates": {
      "X": 2650.0,
      "Y": 2300.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 75.0,
    "Net_Power_kW": -75.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -9.439874802292291,
    "VMag_pu": 0.7803382900974801
  },
  {
    "Bus": "61",
    "Coordinates": {
      "X": 3075.0,
      "Y": 1300.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -9.439727464449097,
    "VMag_pu": 0.7803379383064238
  },
  {
    "Bus": "61s",

```

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"Coordinates": {
  "X": 3175.0,
  "Y": 1300.0
},
"DFPs": [],
"Devices": [],
"Gen_kW": 0,
"Load_kW": 0.0,
"Net_Power_kW": 0.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -9.43972746412232,
"VMag_pu": 0.7803379383014127
},
{
  "Bus": "58",
  "Coordinates": {
    "X": 2075.0,
    "Y": 1850.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -122.86155558623543,
  "VMag_pu": 1.1015399928999154
},
{
  "Bus": "59",
  "Coordinates": {
    "X": 1825.0,
    "Y": 1850.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
```

```
"Net_Power_kW": -20.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -122.86155597202998,
"VMag_pu": 1.1015400004191243
},
{
  "Bus": "55",
  "Coordinates": {
    "X": 2600.0,
    "Y": 1500.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -6.755145679371293,
  "VMag_pu": 0.8339847462839124
},
{
  "Bus": "56",
  "Coordinates": {
    "X": 2875.0,
    "Y": 1500.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -6.755145833852437,
  "VMag_pu": 0.8339847512787869
},
{
  "Bus": "18",
```

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"Coordinates": {
  "X": 1500.0,
  "Y": 2325.0
},
"DFPs": [],
"Devices": [],
"Gen_kW": 0,
"Load_kW": 0.0,
"Net_Power_kW": 0.0,
"StorageDevices": [],
"Transformers": [
  {
    "current_kVA": 131.33,
    "loading_percent": 43.78,
    "name": "xfmr_neigh_5",
    "rated_kVA": 300.0,
    "status": "OK"
  }
],
"VAngle": -6.501500870894262,
"VMag_pu": 0.8414845439446338
},
{
  "Bus": "135",
  "Coordinates": {
    "X": 1600.0,
    "Y": 2325.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -6.505496955463405,
  "VMag_pu": 0.8412734774412151
},
{
  "Bus": "35",
```

```
"Coordinates": {
  "X": 1975.0,
  "Y": 2325.0
},
"DFPs": [],
"Devices": [],
"Gen_kW": 0,
"Load_kW": 40.0,
"Net_Power_kW": -40.0,
"StorageDevices": [],
"Transformers": [
  {
    "current_kVA": 112.45,
    "loading_percent": 37.48,
    "name": "xfmr_neigh_7",
    "rated_kVA": 300.0,
    "status": "OK"
  }
],
"VAngle": -7.036720414075921,
"VMag_pu": 0.8311248453165364
},
{
  "Bus": "40",
  "Coordinates": {
    "X": 1975.0,
    "Y": 2575.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -7.334173067305758,
  "VMag_pu": 0.8254901176196527
},
{
  "Bus": "42",
```

```
"Coordinates": {
  "X": 1975.0,
  "Y": 2825.0
},
"DFPs": [],
"Devices": [],
"Gen_kW": 0,
"Load_kW": -1.3873521903420358,
"Net_Power_kW": 1.3873521903420358,
"StorageDevices": [],
"Transformers": [
  {
    "current_kVA": 363.86,
    "loading_percent": 121.29,
    "name": "xfmr_neigh_8",
    "rated_kVA": 300.0,
    "status": "Overloaded"
  }
],
"VAngle": -7.479609725929019,
"VMag_pu": 0.8217828777468859
},
{
  "Bus": "44",
  "Coordinates": {
    "X": 1975.0,
    "Y": 3025.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -7.479613586581803,
  "VMag_pu": 0.8217829221396037
},
{
  "Bus": "47",
```

```

    "Coordinates": {
      "X": 1975.0,
      "Y": 3275.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": -7.2835989992956875,
    "Net_Power_kW": 7.2835989992956875,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -7.479617649726026,
    "VMag_pu": 0.8217829523846302
  },
  {
    "Bus": "49",
    "Coordinates": {
      "X": 2225.0,
      "Y": 3275.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": -1.4024782387779382,
    "Net_Power_kW": 1.4024782387779382,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -7.479620406610274,
    "VMag_pu": 0.8217829730909815
  },
  {
    "Bus": "50",
    "Coordinates": {
      "X": 2475.0,
      "Y": 3275.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": -2.7747043806840717,

```

```

    "Net_Power_kW": 2.7747043806840717,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -7.479622550843915,
    "VMag_pu": 0.82178298919589
  },
  {
    "Bus": "51",
    "Coordinates": {
      "X": 2725.0,
      "Y": 3275.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": -1.3873521903420358,
    "Net_Power_kW": 1.3873521903420358,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -7.47962408242698,
    "VMag_pu": 0.821783000699355
  },
  {
    "Bus": "151",
    "Coordinates": {
      "X": 3187.0,
      "Y": 3928.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -7.479625307641426,
    "VMag_pu": 0.8217830099019529
  },
  {
    "Bus": "300_open",

```



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    "Coordinates": {
      "X": 0.0,
      "Y": 0.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -7.479625307641426,
    "VMag_pu": 0.8217830099019529
  },
  {
    "Bus": "48",
    "Coordinates": {
      "X": 1825.0,
      "Y": 3275.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": -14.567197998591375,
    "Net_Power_kW": 14.567197998591375,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -7.479617760003102,
    "VMag_pu": 0.8217829532128896
  },
  {
    "Bus": "45",
    "Coordinates": {
      "X": 2175.0,
      "Y": 3025.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": -1.3873521903420358,

```

```
"Net_Power_kW": 1.3873521903420358,
"StorageDevices": [],
"Transformers": [],
"VAngle": -7.479614574215853,
"VMag_pu": 0.8217829365000839
},
{
  "Bus": "46",
  "Coordinates": {
    "X": 2475.0,
    "Y": 3025.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": -1.3873521903420358,
  "Net_Power_kW": 1.3873521903420358,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -7.4796151297599875,
  "VMag_pu": 0.8217829445778542
},
{
  "Bus": "43",
  "Coordinates": {
    "X": 2475.0,
    "Y": 2825.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": -2.7747043806840717,
  "Net_Power_kW": 2.7747043806840717,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -122.42260046675854,
  "VMag_pu": 1.091714975897257
},
{
  "Bus": "41",
```

```

    "Coordinates": {
      "X": 2300.0,
      "Y": 2575.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 20.0,
    "Net_Power_kW": -20.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -7.4215311822451575,
    "VMag_pu": 0.8243868899551762
  },
  {
    "Bus": "36",
    "Coordinates": {
      "X": 2075.0,
      "Y": 2000.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -7.062876695409545,
    "VMag_pu": 0.83087960955288
  },
  {
    "Bus": "38",
    "Coordinates": {
      "X": 2325.0,
      "Y": 2000.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 20.0,

```

```

    "Net_Power_kW": -20.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -122.34711441008628,
    "VMag_pu": 1.0894135224403603
  },
  {
    "Bus": "39",
    "Coordinates": {
      "X": 2650.0,
      "Y": 2000.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 20.0,
    "Net_Power_kW": -20.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -7.404621693312083,
    "VMag_pu": 0.824587058888948
  },
  {
    "Bus": "37",
    "Coordinates": {
      "X": 1775.0,
      "Y": 2000.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -7.062877250953686,
    "VMag_pu": 0.8308796177200665
  },
  {
    "Bus": "21",

```

```
"Coordinates": {
  "X": 1500.0,
  "Y": 2625.0
},
"DFPs": [],
"Devices": [],
"Gen_kW": 0,
"Load_kW": 0.0,
"Net_Power_kW": 0.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -6.590972205153847,
"VMag_pu": 0.8397498403505602
},
{
  "Bus": "23",
  "Coordinates": {
    "X": 1500.0,
    "Y": 2875.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -6.665813506764123,
  "VMag_pu": 0.8383058241130245
},
{
  "Bus": "25",
  "Coordinates": {
    "X": 1500.0,
    "Y": 3150.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
```

```

    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -6.748437584827805,
    "VMag_pu": 0.8367190615416351
  },
  {
    "Bus": "25r",
    "Coordinates": {
      "X": 1500.0,
      "Y": 3150.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [
      {
        "current_kVA": 161.06,
        "loading_percent": 53.69,
        "name": "xfmr_neigh_6",
        "rated_kVA": 300.0,
        "status": "OK"
      }
    ],
    "VAngle": -6.749015552263006,
    "VMag_pu": 0.8367144321881046
  },
  {
    "Bus": "26",
    "Coordinates": {
      "X": 1150.0,
      "Y": 3150.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,

```

```
"Net_Power_kW": 0.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -6.7490158643223115,
"VMag_pu": 0.8367144759914232
},
{
  "Bus": "31",
  "Coordinates": {
    "X": 1150.0,
    "Y": 3375.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": 124.14789253096986,
  "VMag_pu": 1.0092450710456362
},
{
  "Bus": "32",
  "Coordinates": {
    "X": 1150.0,
    "Y": 3675.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": 124.14789197542572,
  "VMag_pu": 1.0092450809660778
},
{
  "Bus": "27",
```

```

    "Coordinates": {
      "X": 875.0,
      "Y": 3150.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -6.749016538524453,
    "VMag_pu": 0.836714501450404
  },
  {
    "Bus": "33",
    "Coordinates": {
      "X": 875.0,
      "Y": 3650.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -6.749018081702654,
    "VMag_pu": 0.8367145242963518
  },
  {
    "Bus": "28",
    "Coordinates": {
      "X": 1500.0,
      "Y": 3350.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,

```



```
"Net_Power_kW": -40.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -6.748438573834246,
"VMag_pu": 0.8367190823618053
},
{
  "Bus": "29",
  "Coordinates": {
    "X": 1500.0,
    "Y": 3650.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -6.748439666946608,
  "VMag_pu": 0.8367191053735729
},
{
  "Bus": "30",
  "Coordinates": {
    "X": 1850.0,
    "Y": 3650.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -6.748440350141824,
  "VMag_pu": 0.8367191197559277
},
{
  "Bus": "250",
```

```
"Coordinates": {
  "X": 2050.0,
  "Y": 3650.0
},
"DFPs": [],
"Devices": [],
"Gen_kW": 0,
"Load_kW": 0.0,
"Net_Power_kW": 0.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -6.748440454247775,
"VMag_pu": 0.8367191219475247
},
{
  "Bus": "24",
  "Coordinates": {
    "X": 950.0,
    "Y": 2875.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": 124.0961369564844,
  "VMag_pu": 1.0092954082316274
},
{
  "Bus": "22",
  "Coordinates": {
    "X": 975.0,
    "Y": 2625.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
```

```

    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -122.22588286017923,
    "VMag_pu": 1.083727118232034
  },
  {
    "Bus": "19",
    "Coordinates": {
      "X": 1250.0,
      "Y": 2325.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -6.501502259754644,
    "VMag_pu": 0.8414845646232053
  },
  {
    "Bus": "20",
    "Coordinates": {
      "X": 925.0,
      "Y": 2325.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -6.501502911747415,
    "VMag_pu": 0.8414845743306458
  },
  {
    "Bus": "34",

```

```
"Coordinates": {
  "X": 1500.0,
  "Y": 1350.0
},
"DFPs": [],
"Devices": [],
"Gen_kW": 0,
"Load_kW": 40.0,
"Net_Power_kW": -40.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": 122.99167014728172,
"VMag_pu": 1.0104765374468239
},
{
  "Bus": "15",
  "Coordinates": {
    "X": 1500.0,
    "Y": 1250.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": 122.99166919051123,
  "VMag_pu": 1.0104765545528764
},
{
  "Bus": "17",
  "Coordinates": {
    "X": 1850.0,
    "Y": 1250.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
```

```
"Net_Power_kW": -20.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": 122.99166843435393,
"VMag_pu": 1.0104765680721761
},
{
  "Bus": "16",
  "Coordinates": {
    "X": 1500.0,
    "Y": 875.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": 122.99166832247352,
  "VMag_pu": 1.0104765700724807
},
{
  "Bus": "9",
  "Coordinates": {
    "X": 1200.0,
    "Y": 1725.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -3.6870758201857865,
  "VMag_pu": 0.902202841454666
},
{
  "Bus": "9r",
```

```
"Coordinates": {
  "X": 1200.0,
  "Y": 1725.0
},
"DFPs": [],
"Devices": [],
"Gen_kW": 0,
"Load_kW": 0.0,
"Net_Power_kW": 0.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": -3.687075820198873,
"VMag_pu": 0.9022028416607237
},
{
  "Bus": "14",
  "Coordinates": {
    "X": 1200.0,
    "Y": 2150.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 0.0,
  "Net_Power_kW": 0.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -3.687079558548205,
  "VMag_pu": 0.9022029013367451
},
{
  "Bus": "10",
  "Coordinates": {
    "X": 1450.0,
    "Y": 2150.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
```

```

    "Net_Power_kW": -20.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -3.6870799443427464,
    "VMag_pu": 0.9022029074952618
  },
  {
    "Bus": "11",
    "Coordinates": {
      "X": 950.0,
      "Y": 2150.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -3.6870799443427464,
    "VMag_pu": 0.9022029074952618
  },
  {
    "Bus": "12",
    "Coordinates": {
      "X": 1200.0,
      "Y": 1275.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 20.0,
    "Net_Power_kW": -20.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -121.44427561714845,
    "VMag_pu": 1.052510633985231
  },
  {
    "Bus": "3",

```

```
"Coordinates": {
  "X": 700.0,
  "Y": 1250.0
},
"DFPs": [],
"Devices": [],
"Gen_kW": 0,
"Load_kW": 0.0,
"Net_Power_kW": 0.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": 121.05379885552074,
"VMag_pu": 1.0031185655729118
},
{
  "Bus": "5",
  "Coordinates": {
    "X": 1025.0,
    "Y": 1250.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": 121.05379720046213,
  "VMag_pu": 1.0031185949481534
},
{
  "Bus": "6",
  "Coordinates": {
    "X": 1275.0,
    "Y": 1150.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
```



```
"Net_Power_kW": -40.0,
"StorageDevices": [],
"Transformers": [],
"VAngle": 121.05379681466759,
"VMag_pu": 1.003118601795529
},
{
  "Bus": "4",
  "Coordinates": {
    "X": 700.0,
    "Y": 1050.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 40.0,
  "Net_Power_kW": -40.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": 121.05379860861224,
  "VMag_pu": 1.003118569955232
},
{
  "Bus": "2",
  "Coordinates": {
    "X": 700.0,
    "Y": 1675.0
  },
  "DFPs": [],
  "Devices": [],
  "Gen_kW": 0,
  "Load_kW": 20.0,
  "Net_Power_kW": -20.0,
  "StorageDevices": [],
  "Transformers": [],
  "VAngle": -120.67440180430384,
  "VMag_pu": 1.02403059459418
},
{
  "Bus": "610",
```

```

    "Coordinates": {
      "X": 3275.0,
      "Y": 1300.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -3.3413910410879923,
    "VMag_pu": 0.9191286751590901
  },
  {
    "Bus": "150r",
    "Coordinates": {
      "X": 100.0,
      "Y": 1500.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,
    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -0.00362165664550092,
    "VMag_pu": 0.9999552667758075
  },
  {
    "Bus": "901",
    "Coordinates": {
      "X": 0.0,
      "Y": 0.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 0.0,

```

```

    "Net_Power_kW": 0.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -7.394713532518734,
    "VMag_pu": 1980.822780605335
  },
  {
    "Bus": "903",
    "Coordinates": {
      "X": 0.0,
      "Y": 0.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 100.0,
    "Net_Power_kW": -100.0,
    "StorageDevices": [],
    "Transformers": [],
    "VAngle": -7.4253421651658025,
    "VMag_pu": 1979.9269173596144
  }
],
"management_status": {
  "management_log": [
    "Iteration 1: Detected 2 overloaded transformer(s).",
    "-> STAGE 1: Checking all neighborhoods for any net-generation...",
    "-> No net-exporting neighborhoods found anywhere in the system.",
    "-> STAGE 2: Proceeding with load reduction for importing neighborhoods.",
    "--> Action: Reducing load in importing neighborhood 8 by 157.04 kW.",
    "--> Action: Reducing load in importing neighborhood 11 by 21.24 kW.",
    "Iteration 2: Detected 2 overloaded transformer(s).",
    "-> STAGE 1: Checking all neighborhoods for any net-generation...",
    "-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",
    "-> Total transformer overload to be corrected: 85.03 kW.",
    "--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",
    "---> Curtailing generation in neighborhood 8 by 34.35 kW.",
    "Iteration 3: Detected 2 overloaded transformer(s).",
    "-> STAGE 1: Checking all neighborhoods for any net-generation...",
    "-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",

```

"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 4: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 5: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 6: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 7: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 8: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 9: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 10: Detected 2 overloaded transformer(s).",

"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 11: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 12: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 13: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 14: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 15: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 16: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",

"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 17: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 18: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 19: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 20: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 21: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 22: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 23: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",

"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 24: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 25: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 26: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 27: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 28: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 29: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 30: Detected 2 overloaded transformer(s).",

"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 31: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 32: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 33: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 34: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 35: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 36: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",



"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 37: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 38: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 39: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 40: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 41: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 42: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 43: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",

"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 44: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 45: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 46: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 47: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 48: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 49: Detected 2 overloaded transformer(s).",  
"-> STAGE 1: Checking all neighborhoods for any net-generation...",  
"-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",  
"-> Total transformer overload to be corrected: 85.03 kW.",  
"--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",  
"---> Curtailing generation in neighborhood 8 by 34.35 kW.",  
"Iteration 50: Detected 2 overloaded transformer(s).",

```

    "-> STAGE 1: Checking all neighborhoods for any net-generation...",
    "-> Found 1 exporting neighborhood(s) with a total net export of 34.35 kW.",
    "-> Total transformer overload to be corrected: 85.03 kW.",
    "--> Action: Curtailing a total of 34.35 kW from exporting neighborhoods.",
    "---> Curtailing generation in neighborhood 8 by 34.35 kW.",
    "Warning: System could not be stabilized within the 50 iteration limit."
  ],
  "status": "ALERT"
},
"power_summary": {
  "circuit_loading_percent": -12.68,
  "converged": true,
  "maximum_circuit_load_kW": 3590.0,
  "maximum_circuit_power_kVA": 21350.0,
  "total_circuit_power_kW": -2707.12,
  "total_gen_kW": 0,
  "total_load_kW": 2864.28,
  "total_losses_kW": 321.0714
},
"voltage_profile": {
  "avg_voltage_pu": 30.4151,
  "max_voltage_pu": 1980.8228,
  "min_voltage_pu": 0.7517
}
},
"status": "success"
}

```

## API 21: modify node

### Parameters:

```

"bus_name": "901",
"load_kw": 75.5,
"load_kvar": 30.0

```

### Description:

This API will modify the values of a given household. It will throw an error if the node is not found.

### Response:

```

{
  "message": "Successfully modified node '901'.",
  "status": "success"
}

```

```
}
```

## API 22: delete node

### Parameters:

```
"bus_name": "901"
```

### Description:

This deletes a node from the cache and removes it from the neighborhood it belongs to.

### Response:

```
{  
  "message": "Successfully deleted node '901' and disabled 2 connected line(s).",  
  "status": "success"  
}
```

## API 23: get dfp details

### Parameters:

```
none
```

### Description:

Prints every DFP and its attributes

### Response:

```
{  
  "dfps": [  
    {  
      "description": "I really really hate DFPs",  
      "index": 1,  
      "min_power_kw": 15.0,  
      "name": "Peak Power Shaving 2",  
      "registered_at": "2025-07-11 15:56:18",  
      "subscribed_buses": [  
        "150",  
        "149",  
        "1",  
        "7",  
        "3",  
        "5",  
        "4",  
        "2"  
      ],  
      "target_pf": 0.8  
    }  
  ]  
}
```

```

    },
    {
      "description": "I hate DFPs",
      "index": 2,
      "min_power_kw": 100.0,
      "name": "Peak Power Shaving 3",
      "registered_at": "2025-07-11 15:56:58",
      "subscribed_buses": [],
      "target_pf": 0.9
    }
  ],
  "status": "success"
}

```

## API 24: send dfp to neighborhood

### Parameters:

```

    "neighbourhood": 1,
    "dfp_name": "Peak Power Shaving 3"

```

### Description:

Sends a given DFP to a given neighborhood and randomly subscribes half of the nodes to the program. These houses, when later executed at a particular time, will have a choice to accept or reject the DFP.

### Response:

```

{
  "details": [
    {
      "bus_name": "150",
      "status": "subscribed"
    },
    {
      "bus_name": "150r",
      "status": "not_subscribed"
    },
    {
      "bus_name": "149",
      "status": "subscribed"
    },
    {
      "bus_name": "1",

```

```

        "status": "subscribed"
    },
    {
        "bus_name": "2",
        "status": "subscribed"
    },
    {
        "bus_name": "197",
        "status": "not_subscribed"
    },
    {
        "bus_name": "3",
        "status": "subscribed"
    },
    {
        "bus_name": "4",
        "status": "subscribed"
    },
    {
        "bus_name": "5",
        "status": "subscribed"
    },
    {
        "bus_name": "6",
        "status": "not_subscribed"
    },
    {
        "bus_name": "7",
        "status": "subscribed"
    }
],
"message": "Sent DFP 'Peak Power Shaving 2' to neighbourhood 1. Subscribed 8 out of
11 valid buses.",
"status": "success"
}

```

## API 25: get node details

### Parameters:

"bus\_name": "1"

### Description:

This is very similar to API I, except instead of details for the entire grid it shows all details for a single node. It throws an error if the node is not found.

Sends a given DFP to a given neighborhood and randomly subscribes half of the nodes to the program. These houses, when later executed at a particular time, will have a choice to accept or reject the DFP.

Response:

```
{
  "results": {
    "Bus": "1",
    "Coordinates": {
      "X": 700.0,
      "Y": 1500.0
    },
    "DFPs": [],
    "Devices": [],
    "Gen_kW": 0,
    "Load_kW": 40.0,
    "Net_Power_kW": -40.0,
    "StorageDevices": [],
    "Transformers": [
      {
        "current_kVA": 195.33,
        "loading_percent": 65.11,
        "name": "xfmr_neigh_1",
        "rated_kVA": 300.0,
        "status": "OK"
      }
    ],
    "VAngle": -1.430968197646482,
    "VMag_pu": 0.9594130742907941
  },
  "status": "success"
}
```