TCC

1. Introdução

Importando libs

In [13]:
```
import datetime
import numpy as np
import pandas as pd
import py_dss_interface as pydss
import seaborn as sns
import matplotlib.pyplot as plt
import matplotlib.dates as mdates


def str_to_time(string:str):
    return datetime.datetime.strptime(string,'%H:%M')
```

Instanciando py-dss

In [14]:
```
dssObj = pydss.DSS()
project_file = r"C:/Users/gabri/project-tcc/src/circbtfull_storage.dss"
dssObj.text(f"compile {project_file}")
```

Out[14]:
```
''
```

Coletando itens da aplicação

In [15]:
```
nodes_names = dssObj.circuit.nodes_names
elements_names = dssObj.circuit.elements_names
buses_names=dssObj.circuit.buses_names
num_buses = dssObj.circuit.num_buses
num_cktelement = dssObj.circuit.num_ckt_elements
```

2. Simulação de caso inicial

Nesta primeira etapa iremos analisar o circuito BT sem a presença de geradores fotovoltaicos, bem como de sistemas de armazenamento de energia

In [16]:
```
for element in elements_names:
    dssObj.circuit.set_active_element(element)
    if not (element.find("Generator.") == -1  and element.find("Storage.") == -1
        if dssObj.cktelement.is_enabled == 1:
            dssObj.cktelement.enabled(0)
```

In [17]:
```
step_size_min = 15
step_size_sec = 60*step_size_min # SEGUNDOS
total_time_hour = 24 # hours
total_simulations = int(total_time_hour * 60 / step_size_min)
```

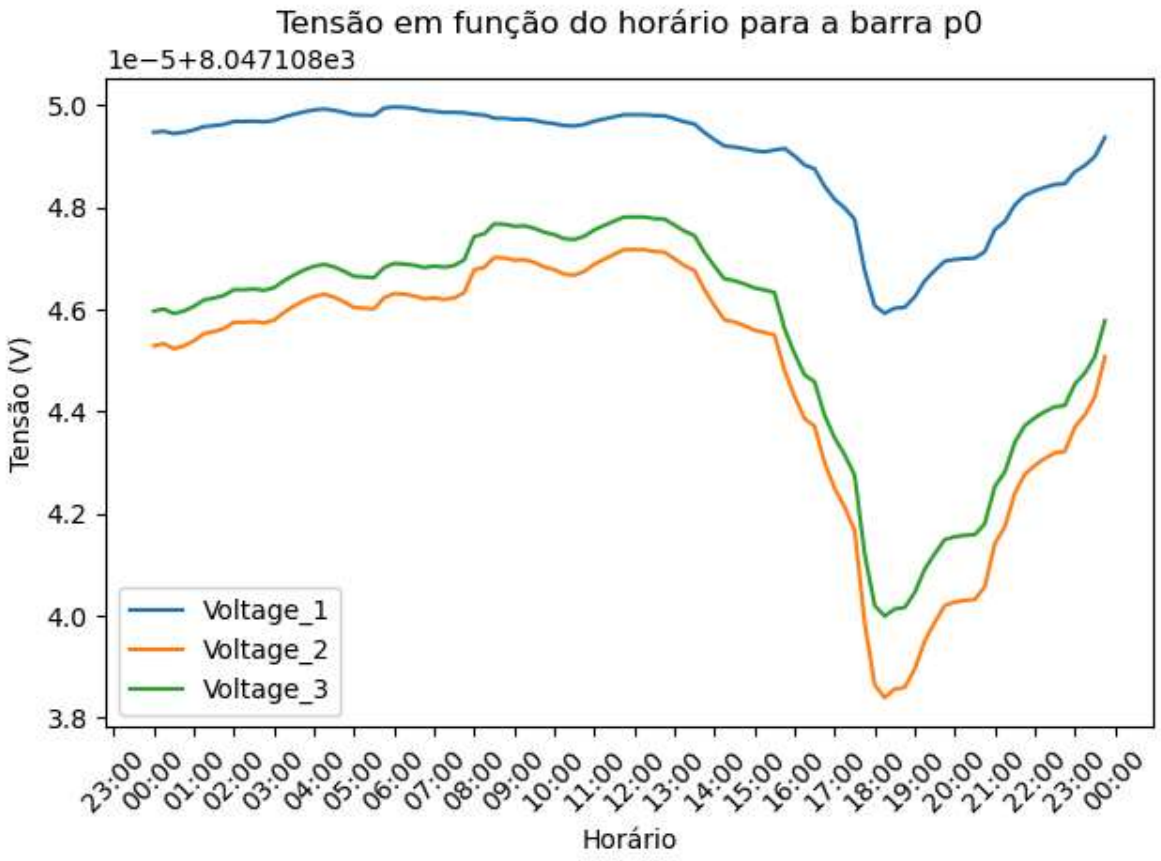
```
dssObj.solution.mode = 1
dssObj.solution.step_size = step_size_sec ## ESTE VALOR DETERMINA O STEP_SIZE EM
dssObj.solution.number = 1 ## ESTE DETERMINA QUANTAS VEZES É EXECTUADO O PASSO N
```

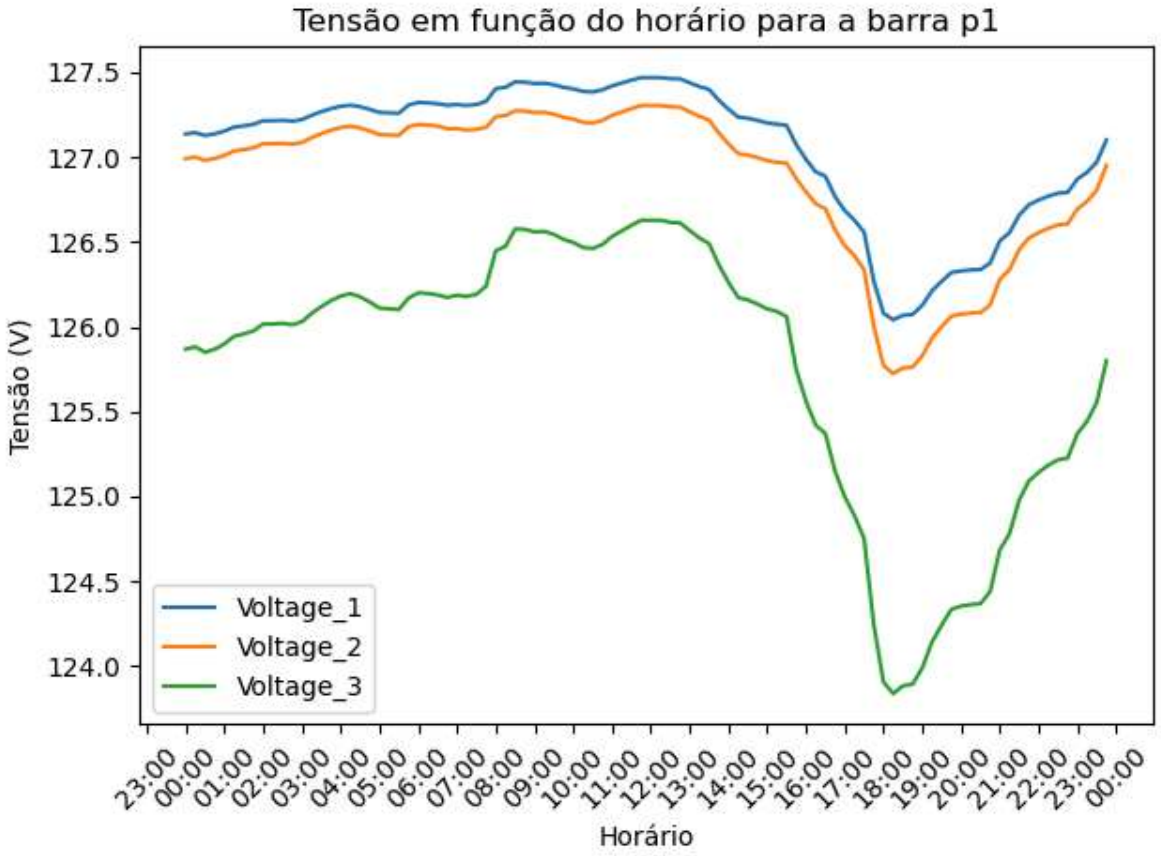
Coletaremos a curva de tensão, e de potência de cada barra do circuito

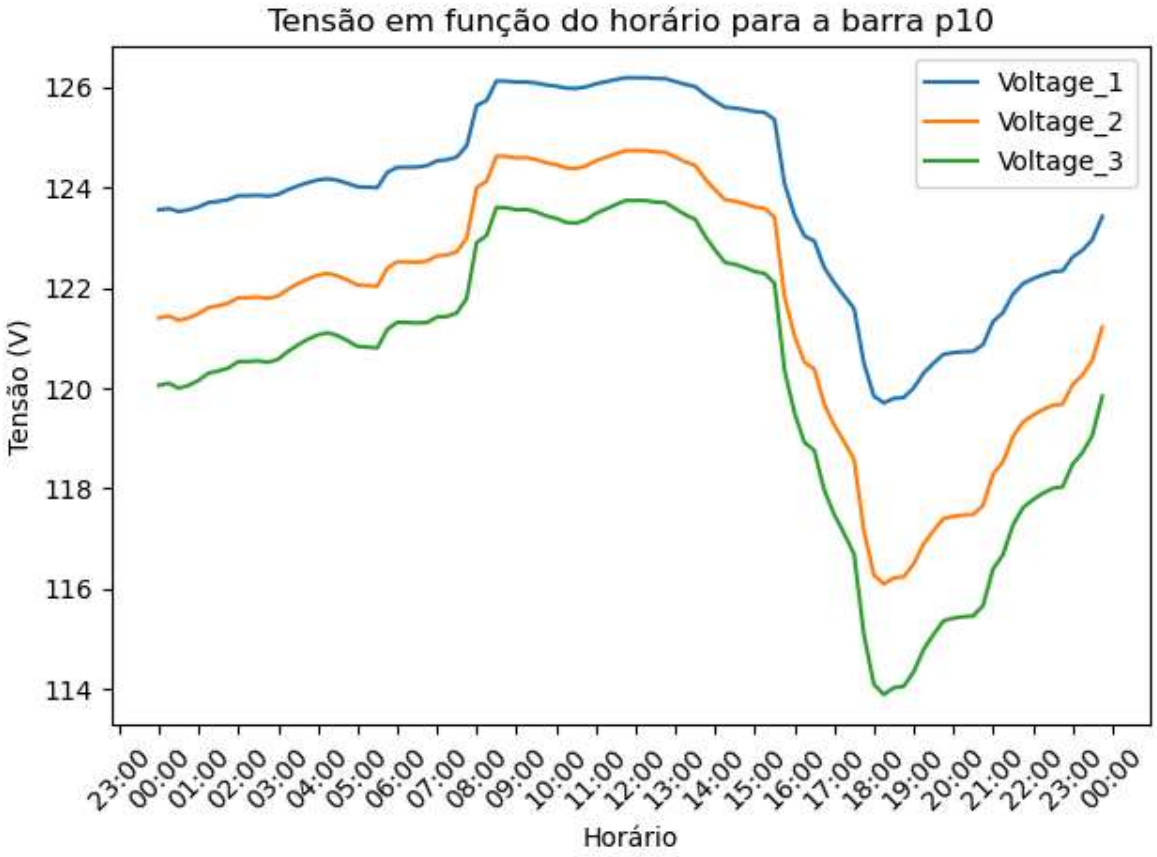
In [18]:
```
header = pd.date_range('00:00:00', periods=total_simulations, freq=f'{step_size_
df = pd.DataFrame(index=nodes_names,columns=header)

for h in range(total_simulations):
    instant = datetime.time(hour=dssObj.solution.hour,minute=int(dssObj.solution
    dssObj.solution.solve()

    bus_voltages = dssObj.circuit.buses_volts
    df[instant] = [
        (bus_voltages[j] + 1j * bus_voltages[j+1]) for j in range(0,len(bus_volt
    ]

df['Bus'] = [
    n.split('.')[0] for n in df.index
]
df['Phase'] = [
    n.split('.')[1] for n in df.index
]
```

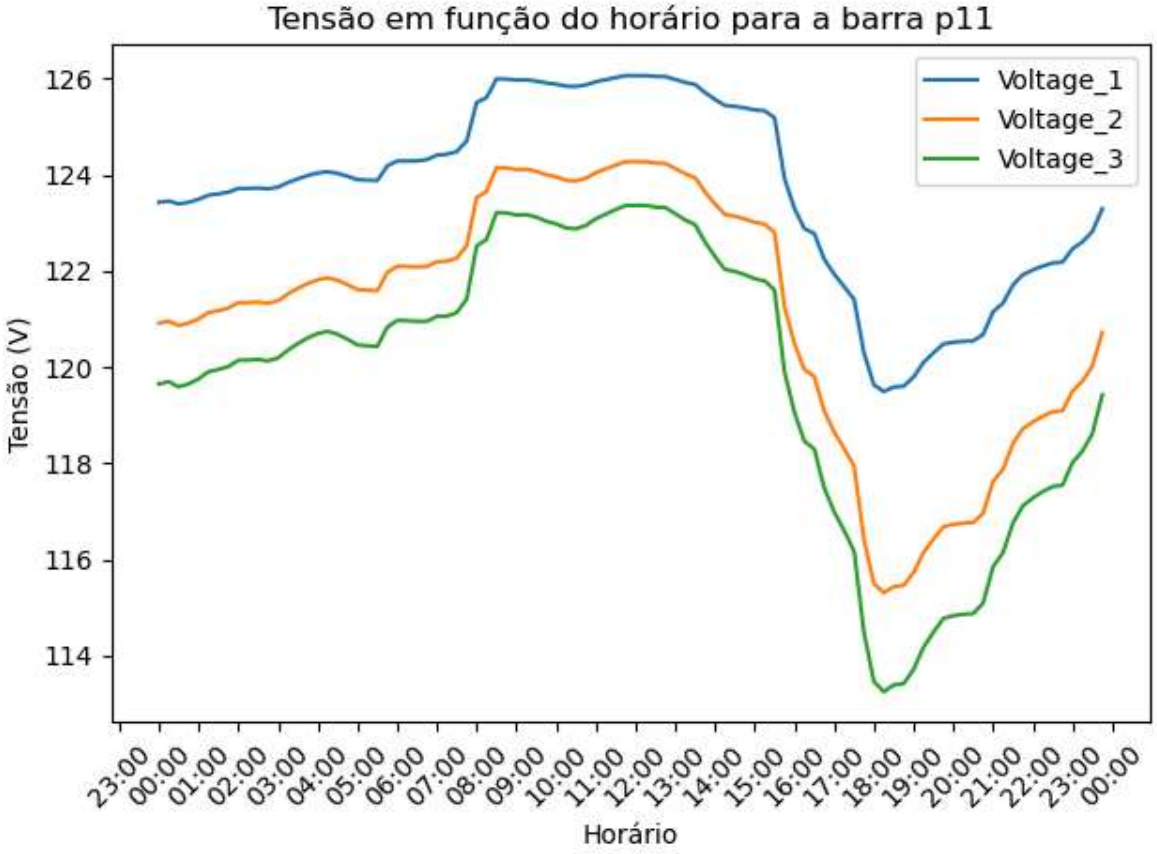
In [19]:
```
grouped = df.groupby('Bus')
rows_subplot = len(df['Bus'].unique())//2 if len(df['Bus'].unique())%2 == 0 else
```

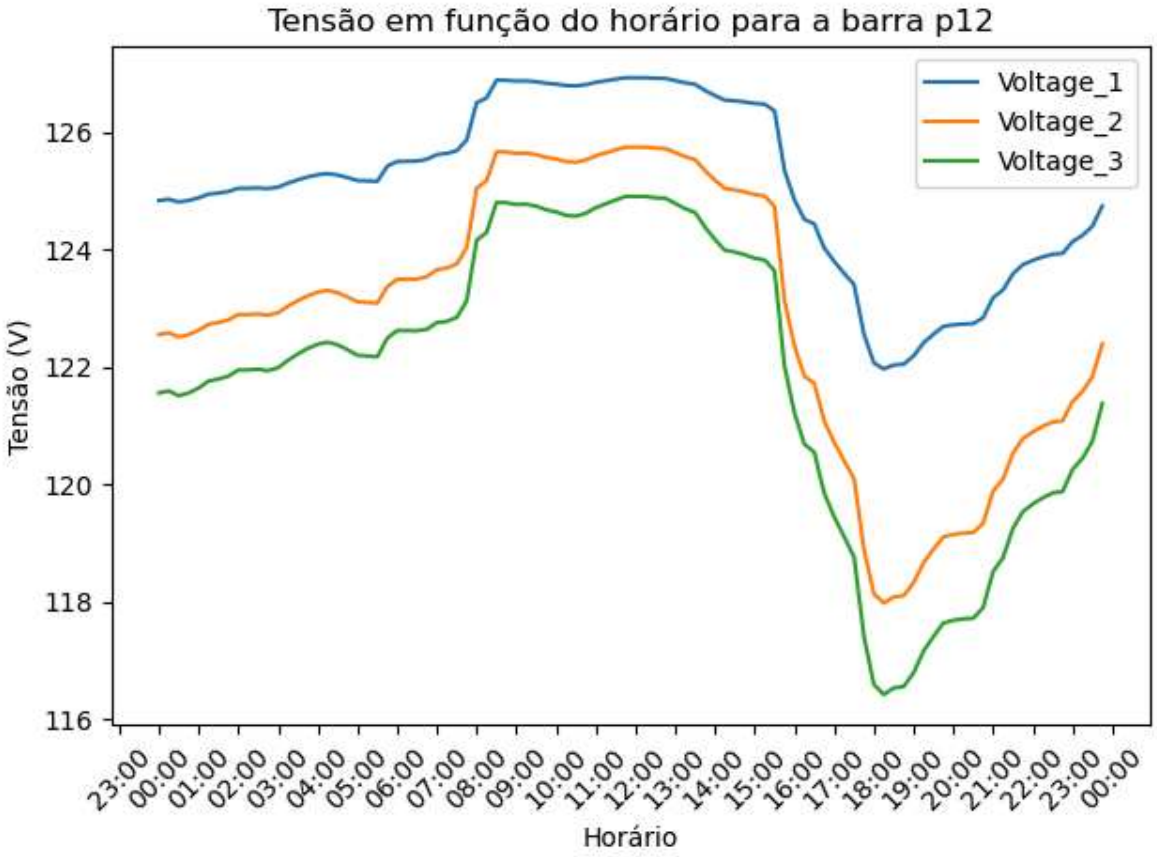
In [20]:
```
for bus,group in grouped:
    group_transposed = group.T
    group_transposed.columns = [f"Voltage_{p}" for p in group_transposed.loc['Ph
    group_transposed = group_transposed.drop(index=['Bus','Phase'])
    if 'Voltage_4' in group_transposed.columns:
        group_transposed = group_transposed.drop(columns="Voltage_4")
    group_transposed = group_transposed.map(abs)
    group_transposed.index = group_transposed.index.map(str_to_time)
    plt.figure()

    for column in group_transposed.columns:
        plt.plot(group_transposed.index, group_transposed[column], label=column)

    plt.title(f'Tensão em função do horário para a barra {bus}')
    plt.xlabel('Horário')
    plt.ylabel('Tensão (V)')
    plt.gca().xaxis.set_major_locator(mdates.HourLocator(interval=1))
    plt.gca().xaxis.set_major_formatter(mdates.DateFormatter('%H:%M'))
    plt.xticks(rotation=45)
    plt.legend()
    plt.tight_layout()
    plt.savefig(f'voltage_plot_{bus}.png')  # Salvando o gráfico como imagem
```

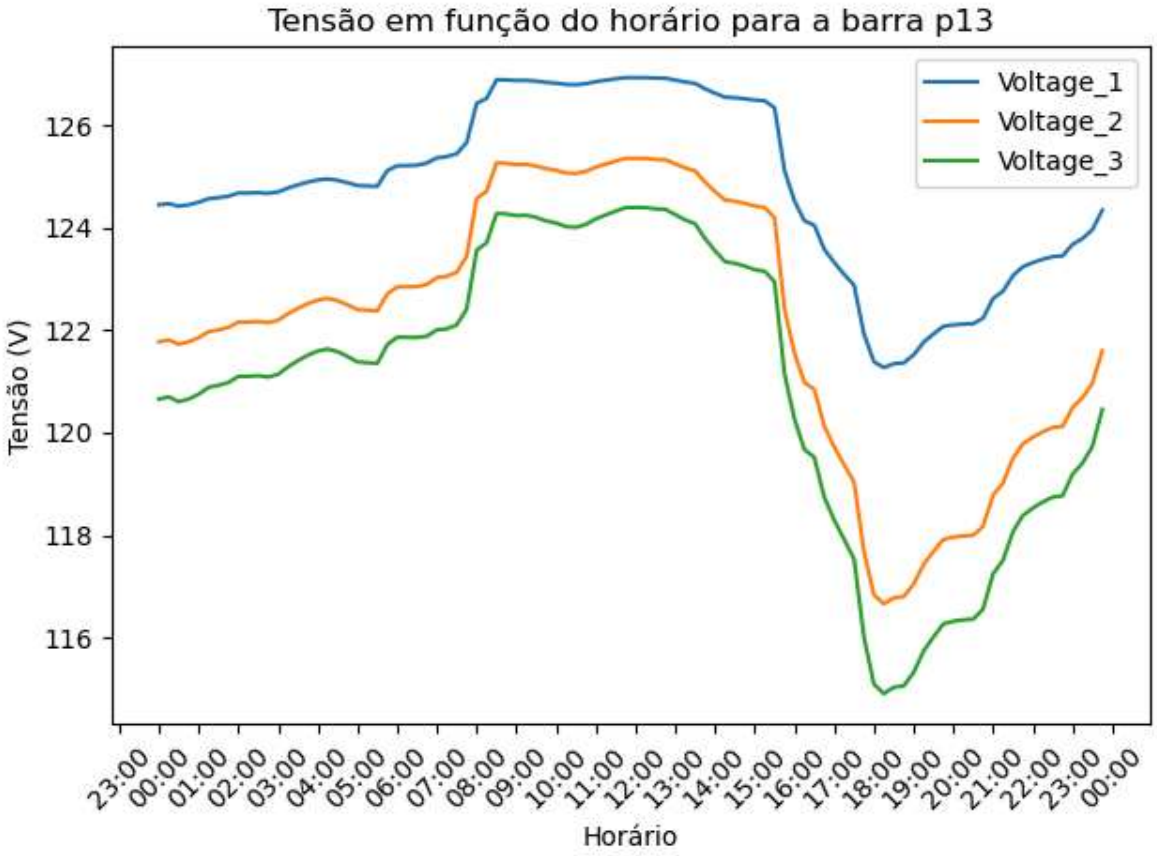

Tensão em função do horário para a barra p0
1e−5+8.047108e3
Tensão (V)
Horário
Voltage_1
Voltage_2
Voltage_3

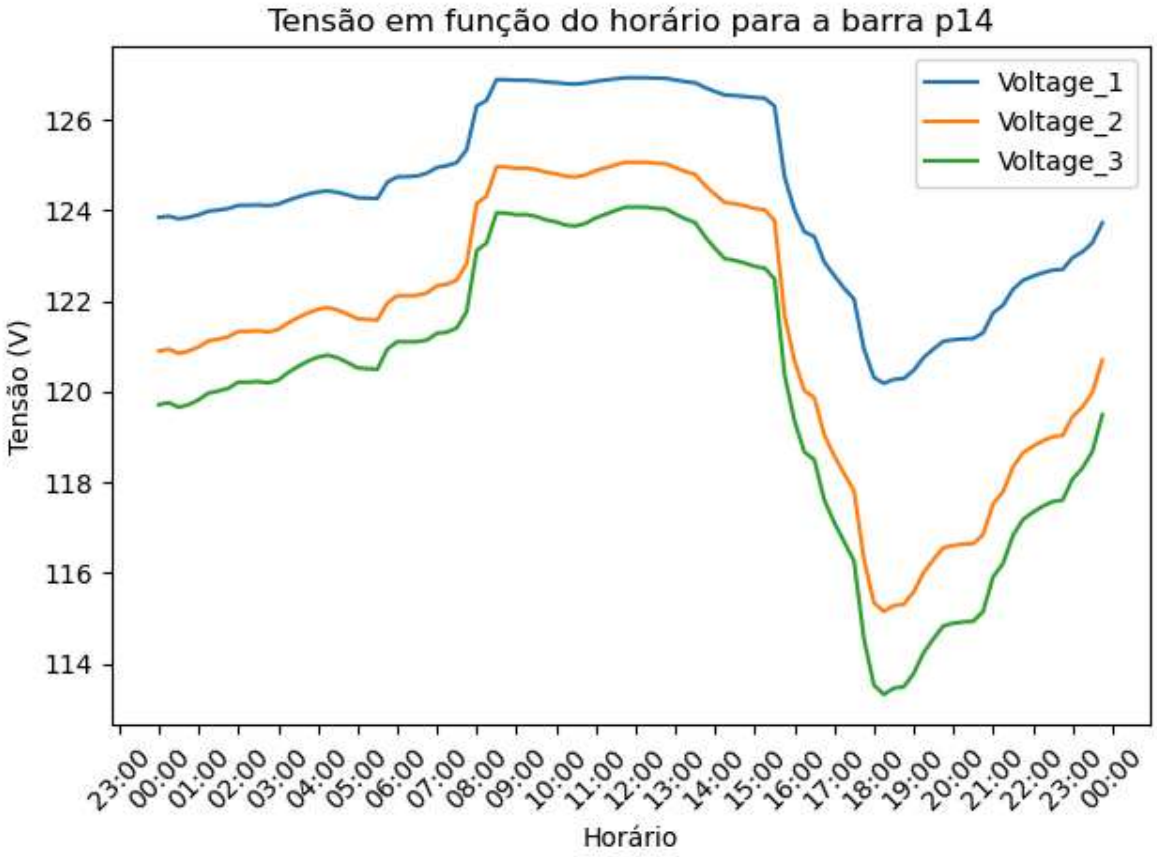

Tensão em função do horário para a barra p1
Tensão (V)
Horário
Voltage_1
Voltage_2
Voltage_3

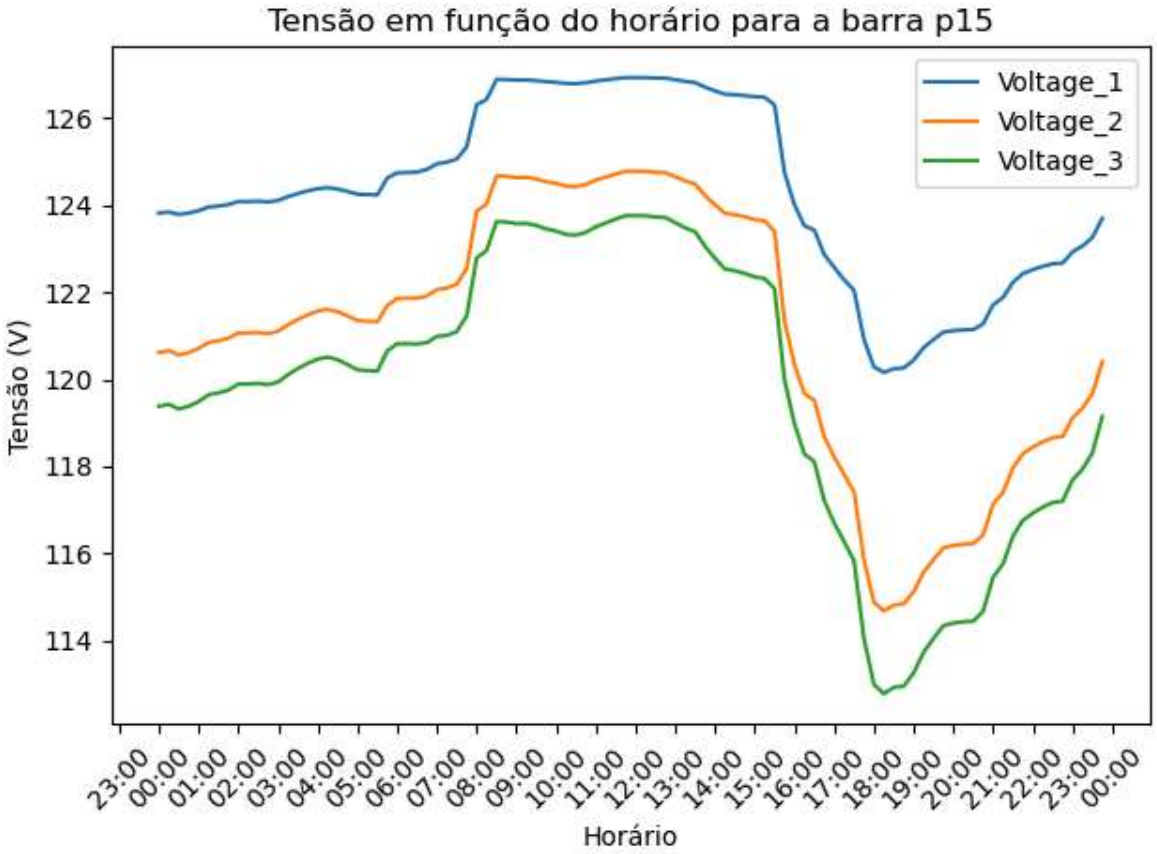

Tensão em função do horário para a barra p10
Voltage_1
Voltage_2
Voltage_3
Tensão (V)
126
124
122
120
118
116
114
23:00
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
Horário

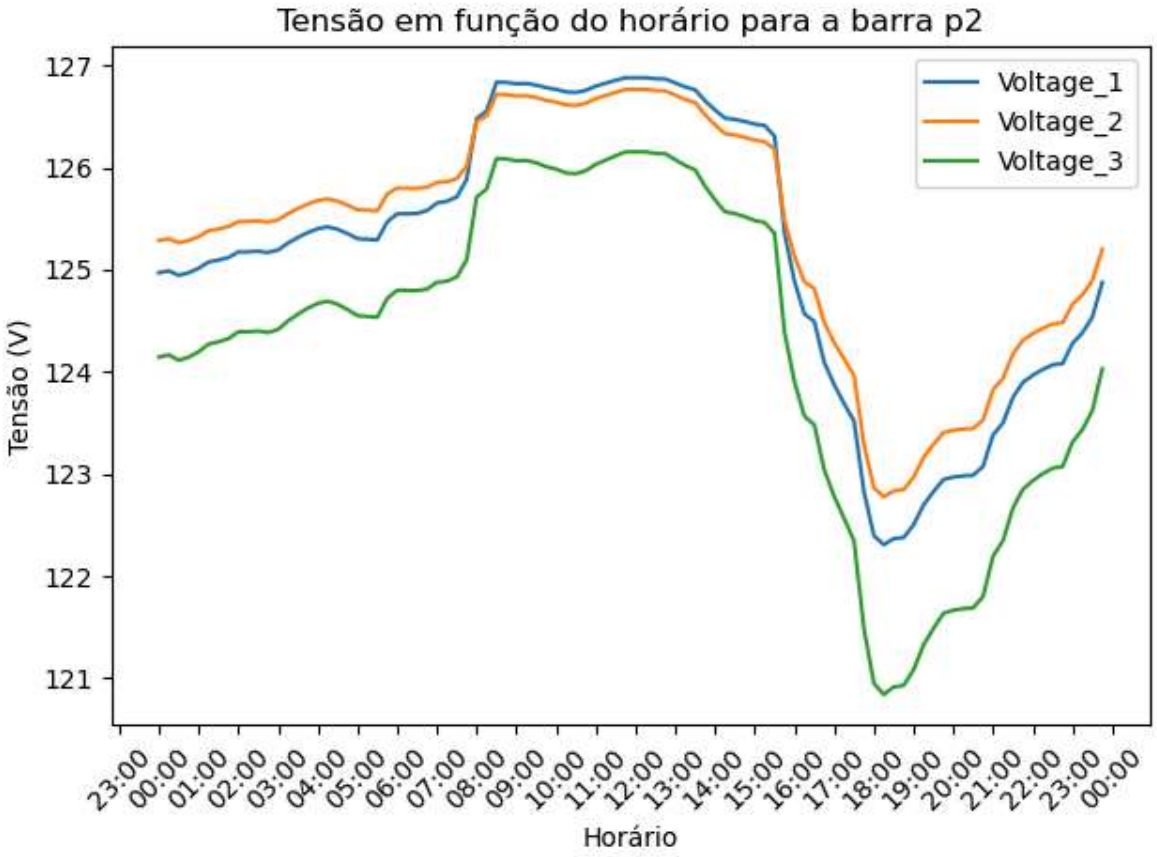

Tensão em função do horário para a barra p11
Voltage_1
Voltage_2
Voltage_3
Tensão (V)
126
124
122
120
118
116
114
23:00
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
Horário

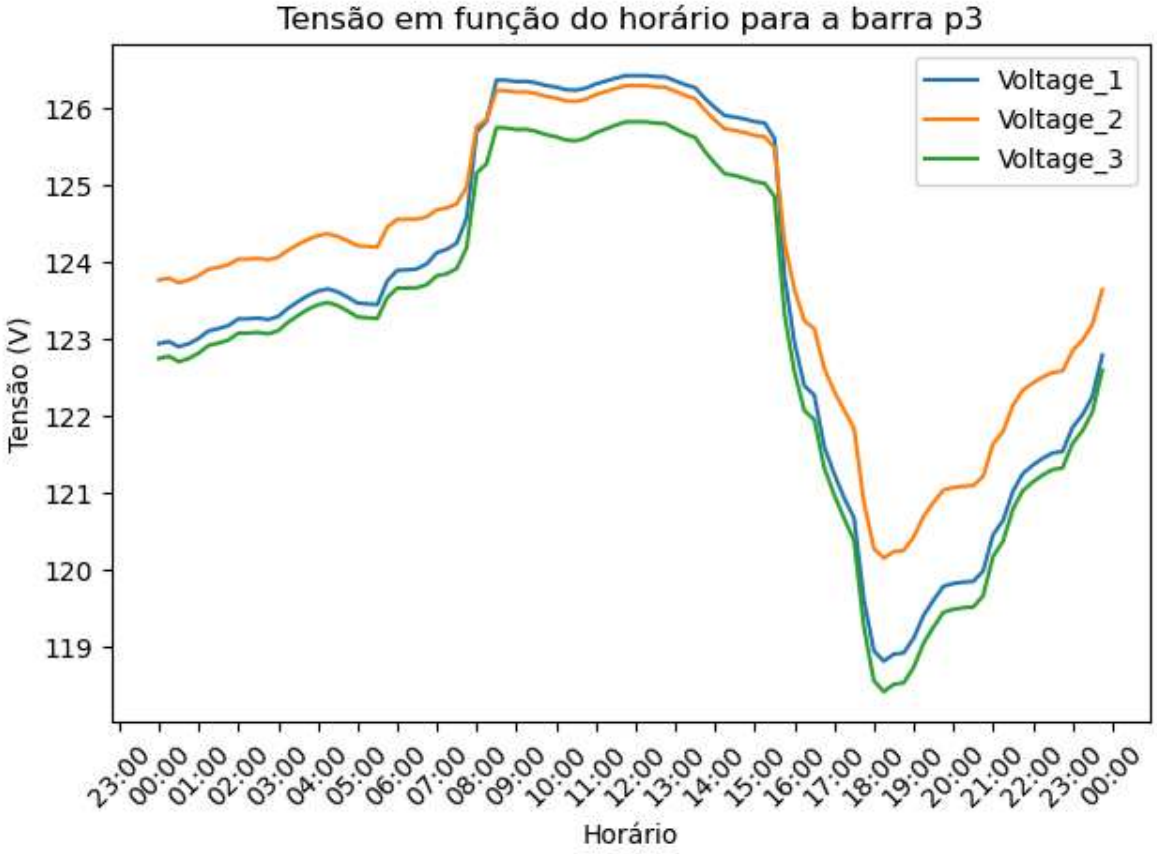

Tensão em função do horário para a barra p12
Voltage_1
Voltage_2
Voltage_3
Tensão (V)
126
124
122
120
118
116
23:00
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
Horário

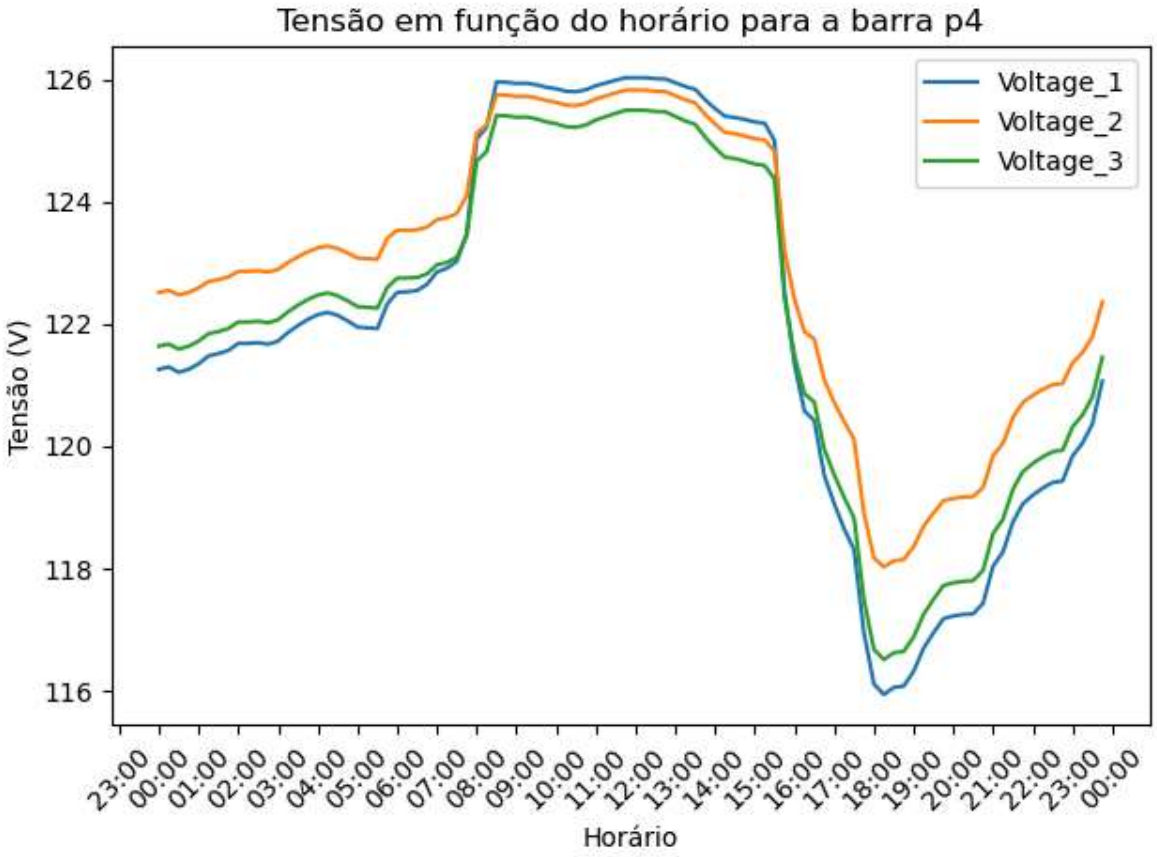

Tensão em função do horário para a barra p13
Voltage_1
Voltage_2
Voltage_3
Tensão (V)
126
124
122
120
118
116
23:00
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
Horário

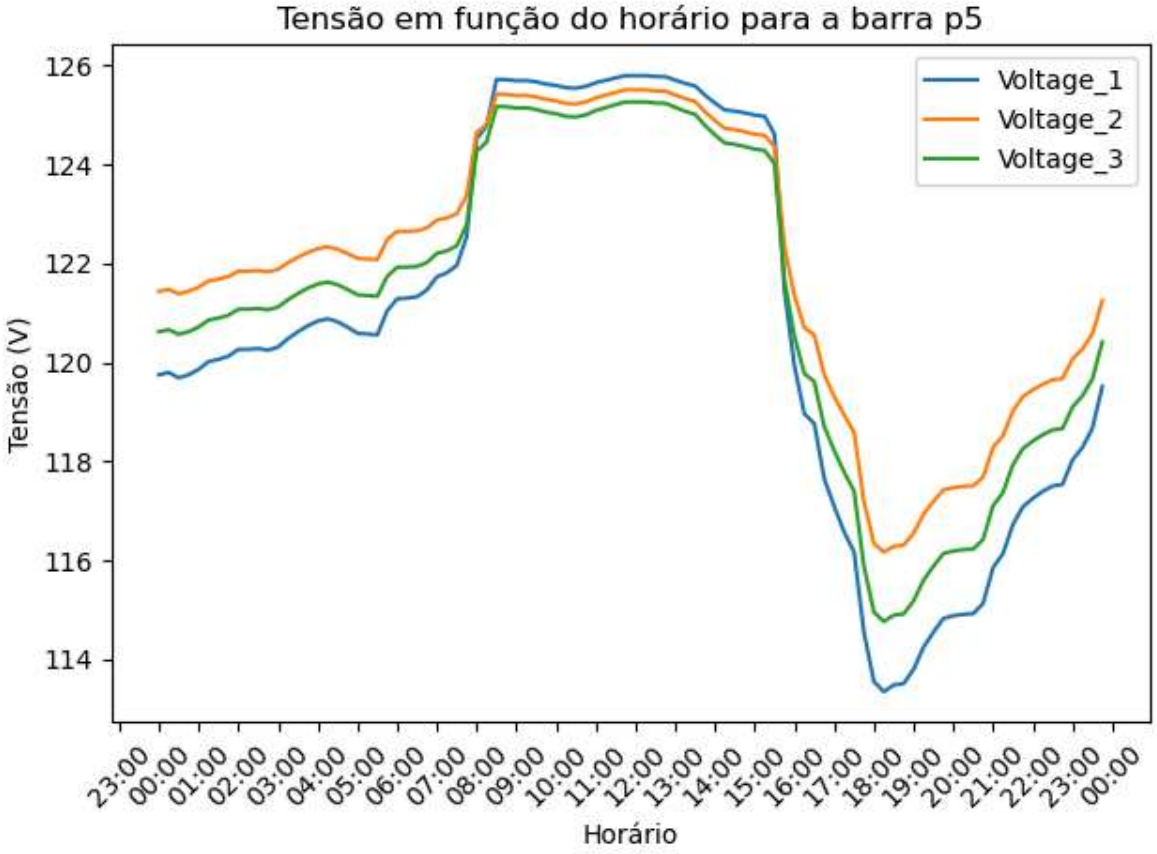

Tensão em função do horário para a barra p14
Voltage_1
Voltage_2
Voltage_3
Tensão (V)
126
124
122
120
118
116
114
23:00
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
Horário

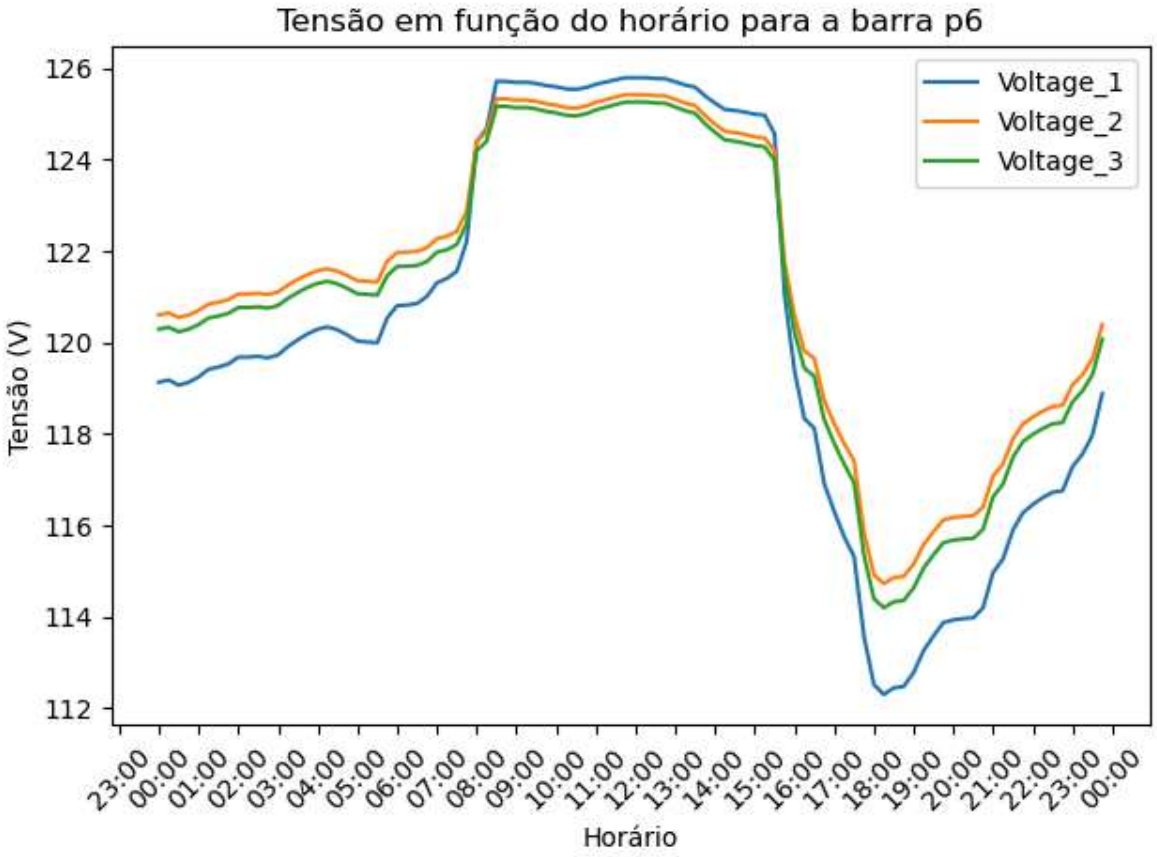

Tensão em função do horário para a barra p15
Voltage_1
Voltage_2
Voltage_3
Tensão (V)
126
124
122
120
118
116
114
23:00
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
Horário

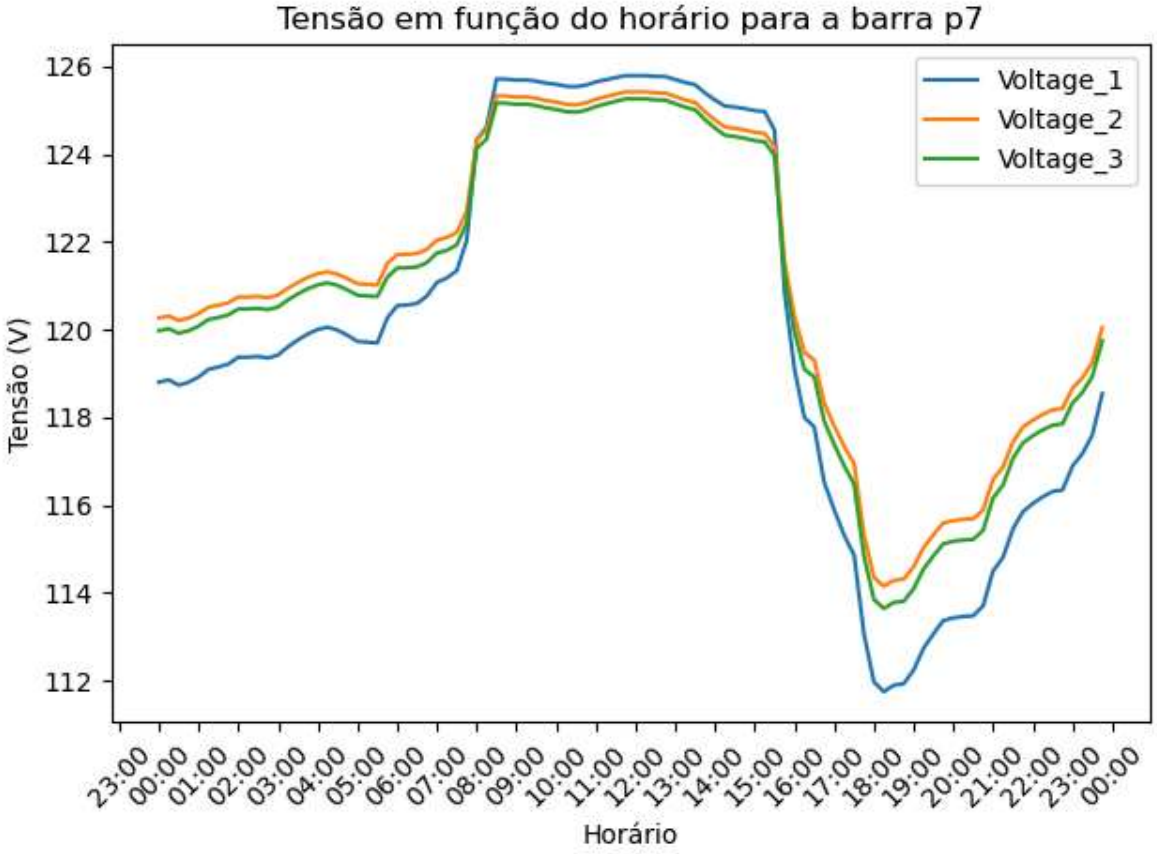

Tensão em função do horário para a barra p2
Voltage_1
Voltage_2
Voltage_3
Tensão (V)
Horário

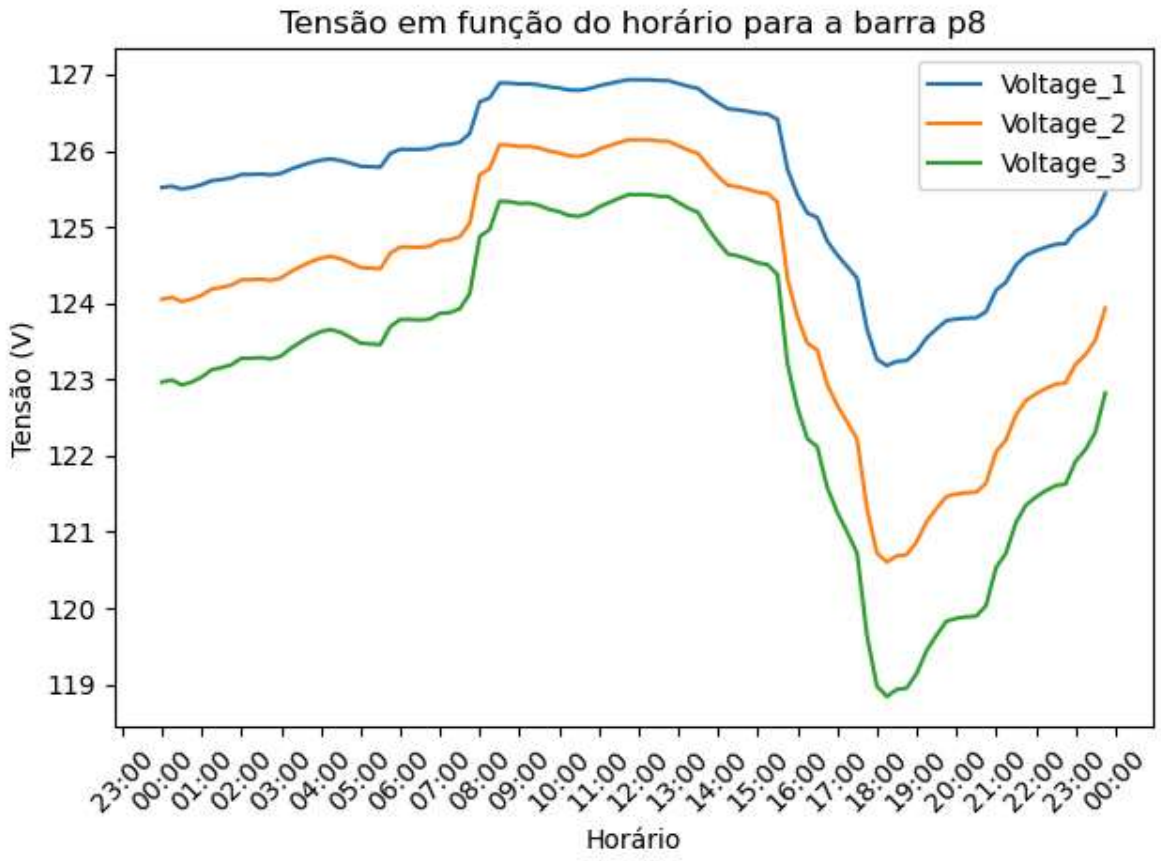

Tensão em função do horário para a barra p3
Voltage_1
Voltage_2
Voltage_3
Tensão (V)
Horário

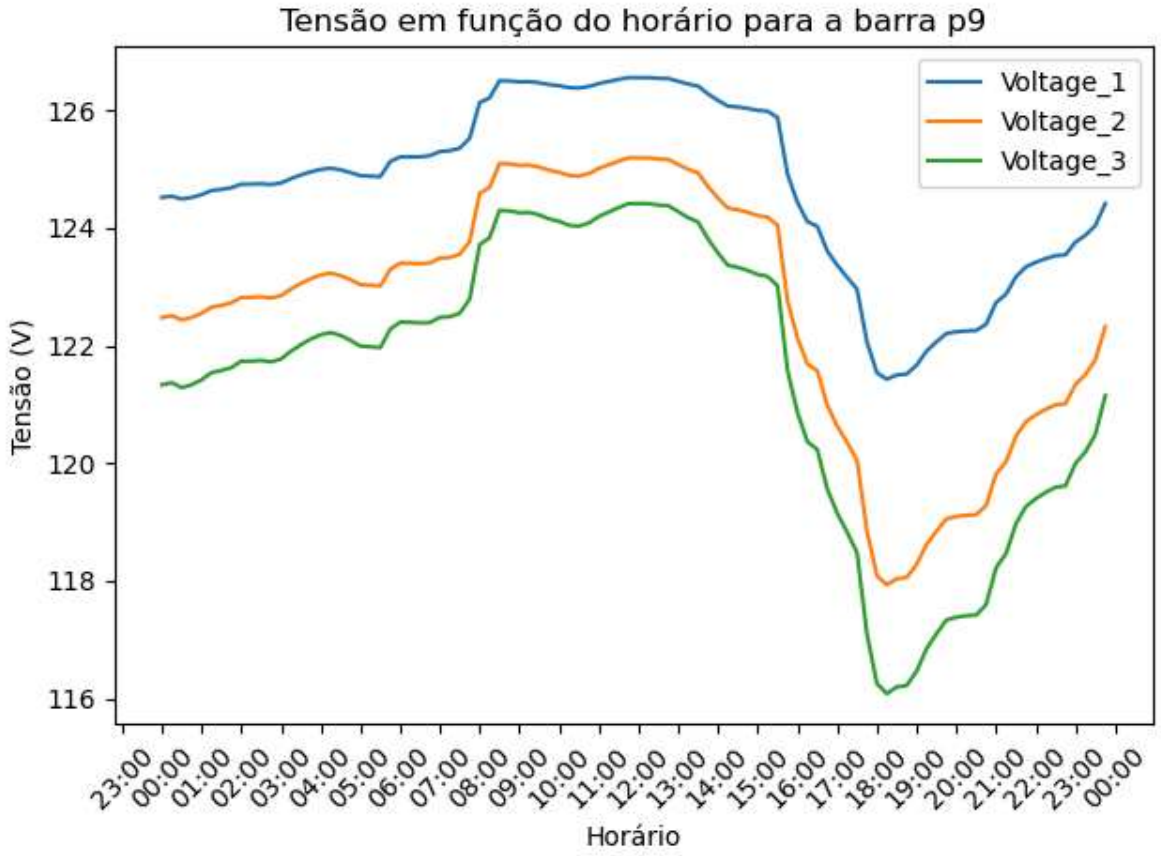

Tensão em função do horário para a barra p4
Voltage_1
Voltage_2
Voltage_3
Tensão (V)
126
124
122
120
118
116
23:00
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
Horário


Tensão em função do horário para a barra p5
Voltage_1
Voltage_2
Voltage_3
Tensão (V)
126
124
122
120
118
116
114
23:00
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
Horário


Tensão em função do horário para a barra p6
Voltage_1
Voltage_2
Voltage_3
Tensão (V)
126
124
122
120
118
116
114
112
23:00
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
Horário


Tensão em função do horário para a barra p7
Voltage_1
Voltage_2
Voltage_3
Tensão (V)
126
124
122
120
118
116
114
112
23:00
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
Horário





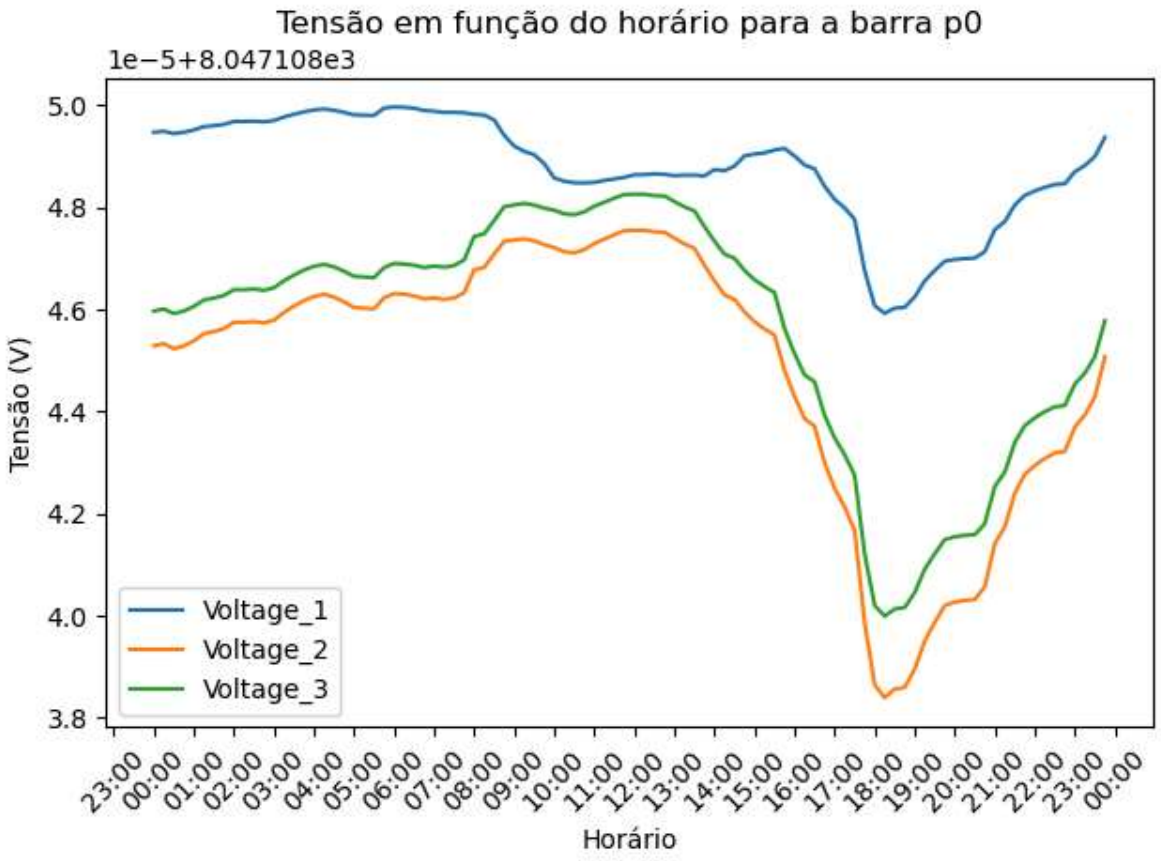
In [21]:
```
for element in elements_names:
    dssObj.circuit.set_active_element(element)
    if not (element.find("Generator.") == -1):
        if dssObj.cktelement.is_enabled == 0:
            dssObj.cktelement.enabled(1)
```

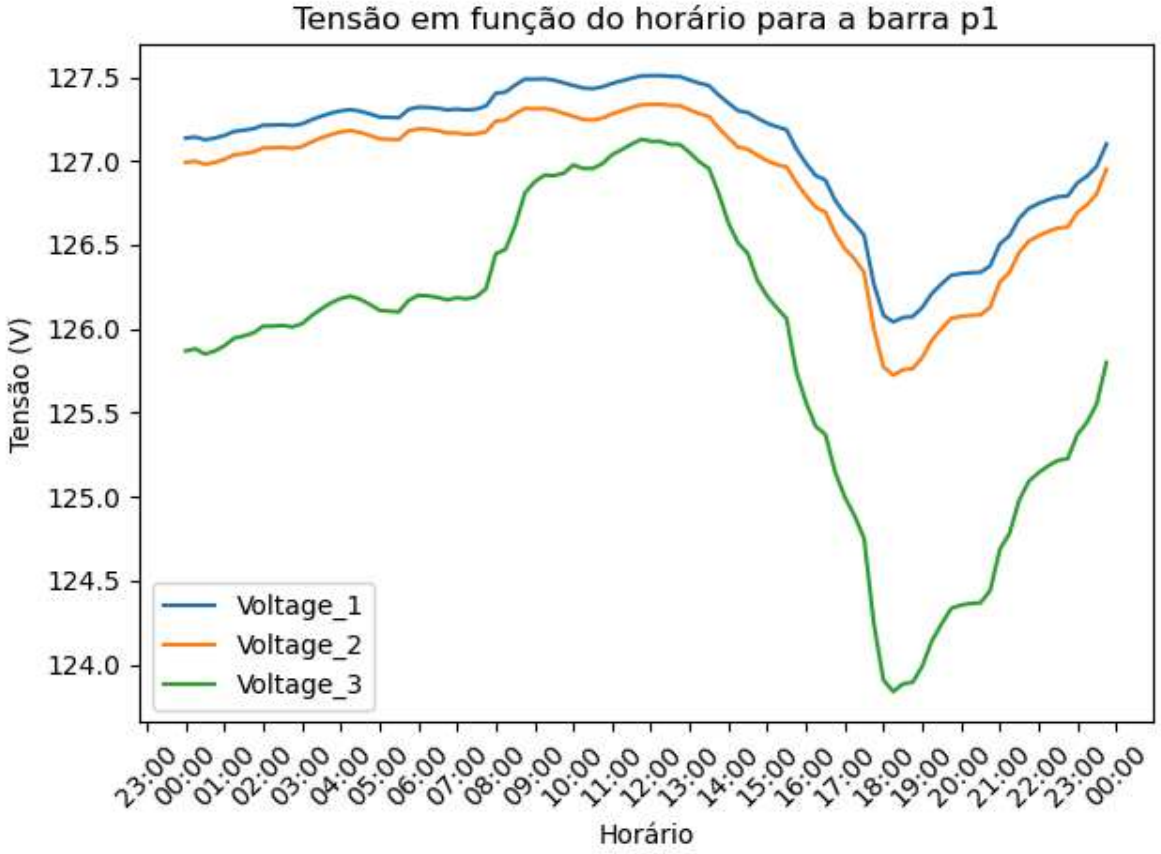
```
dssObj.solution.dbl_hour = 0.0
```

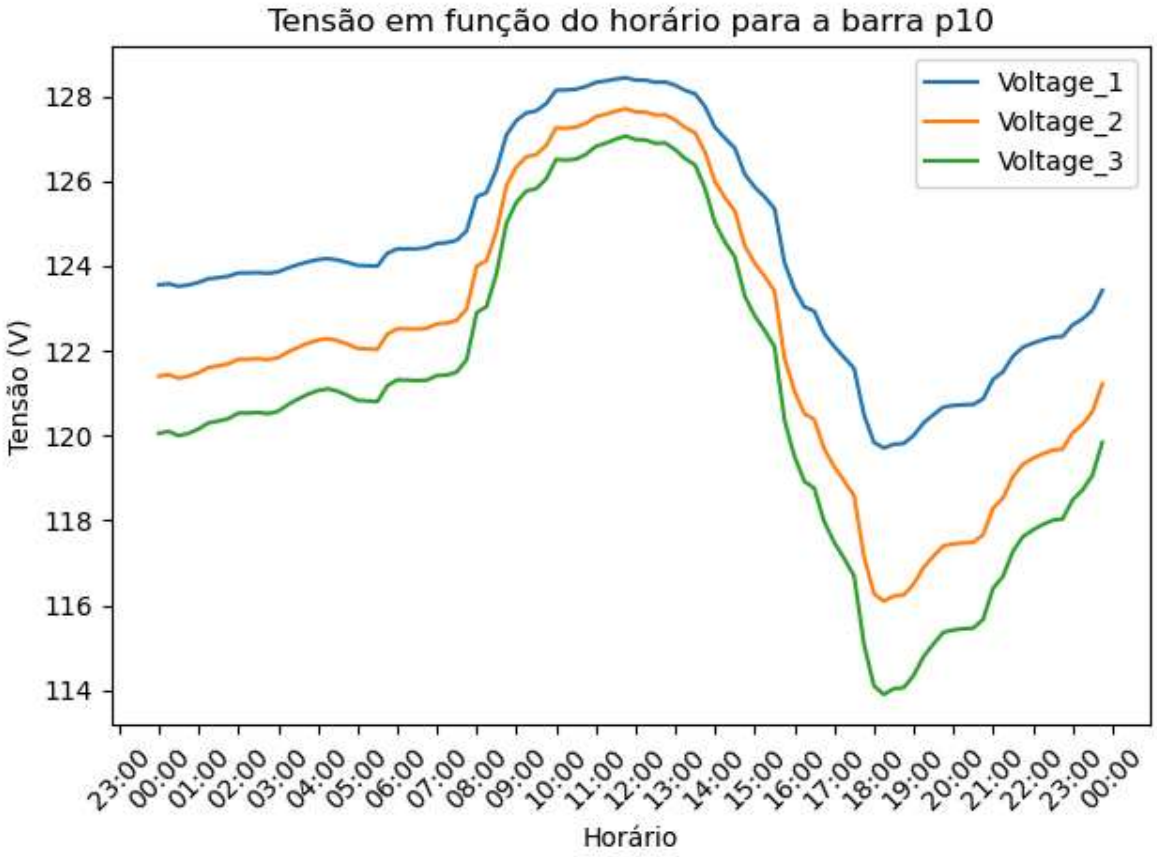
In [22]:
```
header = pd.date_range('00:00:00', periods=total_simulations, freq=f'{step_size_
df_new = pd.DataFrame(index=nodes_names,columns=header)

for h in range(total_simulations):
    instant = datetime.time(hour=dssObj.solution.hour,minute=int(dssObj.solution
    dssObj.solution.solve()

    bus_voltages = dssObj.circuit.buses_volts
    df_new[instant] = [
        (bus_voltages[j] + 1j * bus_voltages[j+1]) for j in range(0,len(bus_volt
    ]
```

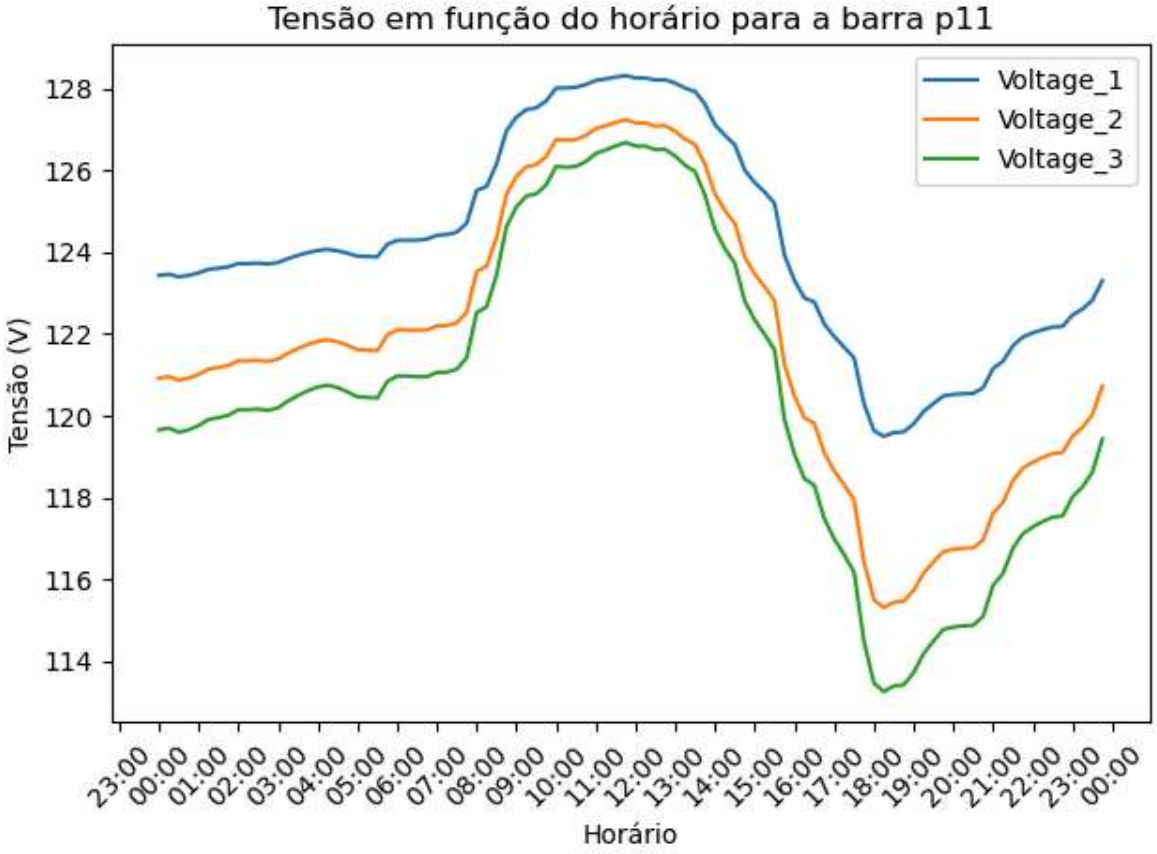
In [23]:
```
df_new['Bus'] = [
    n.split('.')[0] for n in df_new.index
]
df_new['Phase'] = [
    n.split('.')[1] for n in df_new.index
]

grouped_new = df_new.groupby('Bus')
rows_subplot = len(df_new['Bus'].unique())//2 if len(df_new['Bus'].unique())%2 =
```

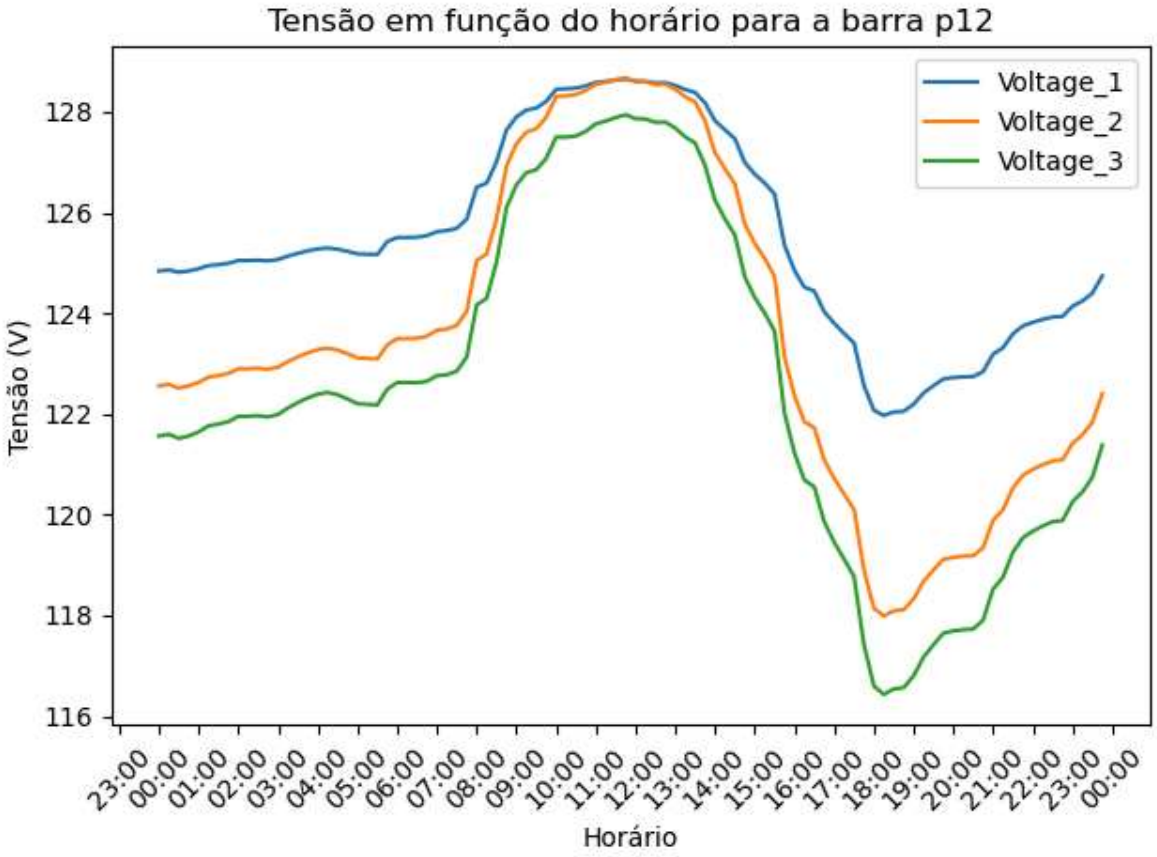
In [24]:
```
for bus,group in grouped_new:
    group_transposed = group.T
    group_transposed.columns = [f"Voltage_{p}" for p in group_transposed.loc['Ph
    group_transposed = group_transposed.drop(index=['Bus','Phase'])
    if 'Voltage_4' in group_transposed.columns:
        group_transposed = group_transposed.drop(columns="Voltage_4")
    group_transposed = group_transposed.map(abs)
    group_transposed.index = group_transposed.index.map(str_to_time)
    plt.figure()

    for column in group_transposed.columns:
        plt.plot(group_transposed.index, group_transposed[column], label=column)

    plt.title(f'Tensão em função do horário para a barra {bus}')
    plt.xlabel('Horário')
    plt.ylabel('Tensão (V)')
    plt.gca().xaxis.set_major_locator(mdates.HourLocator(interval=1))
    plt.gca().xaxis.set_major_formatter(mdates.DateFormatter('%H:%M'))
    plt.xticks(rotation=45)
    plt.legend()
    plt.tight_layout()
    plt.savefig(f'voltage_plot_{bus}.png')  # Salvando o gráfico como imagem
```

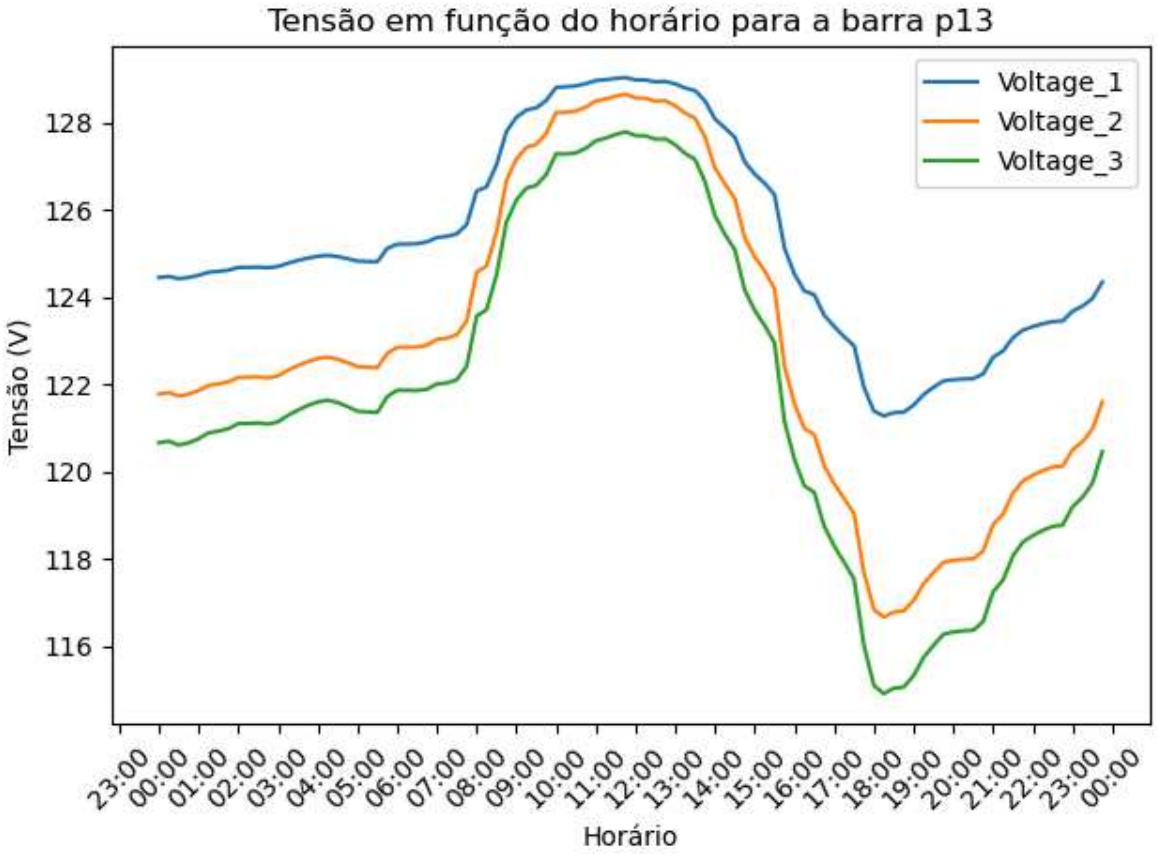

Tensão em função do horário para a barra p0
1e−5+8.047108e3
5.0
4.8
4.6
4.4
4.2
4.0
3.8
Tensão (V)
Voltage_1
Voltage_2
Voltage_3
23:00
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
Horário

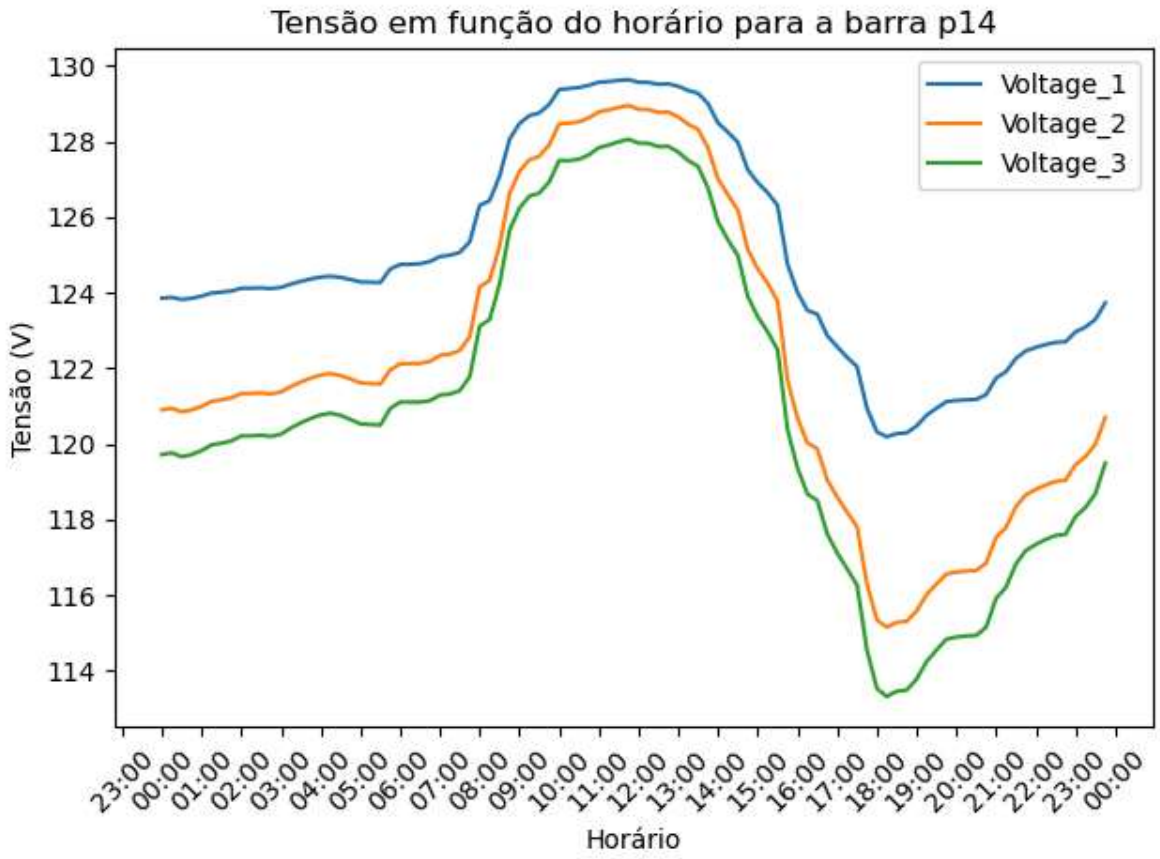

Tensão em função do horário para a barra p1
127.5
127.0
126.5
126.0
125.5
125.0
124.5
124.0
Tensão (V)
Voltage_1
Voltage_2
Voltage_3
23:00
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
Horário

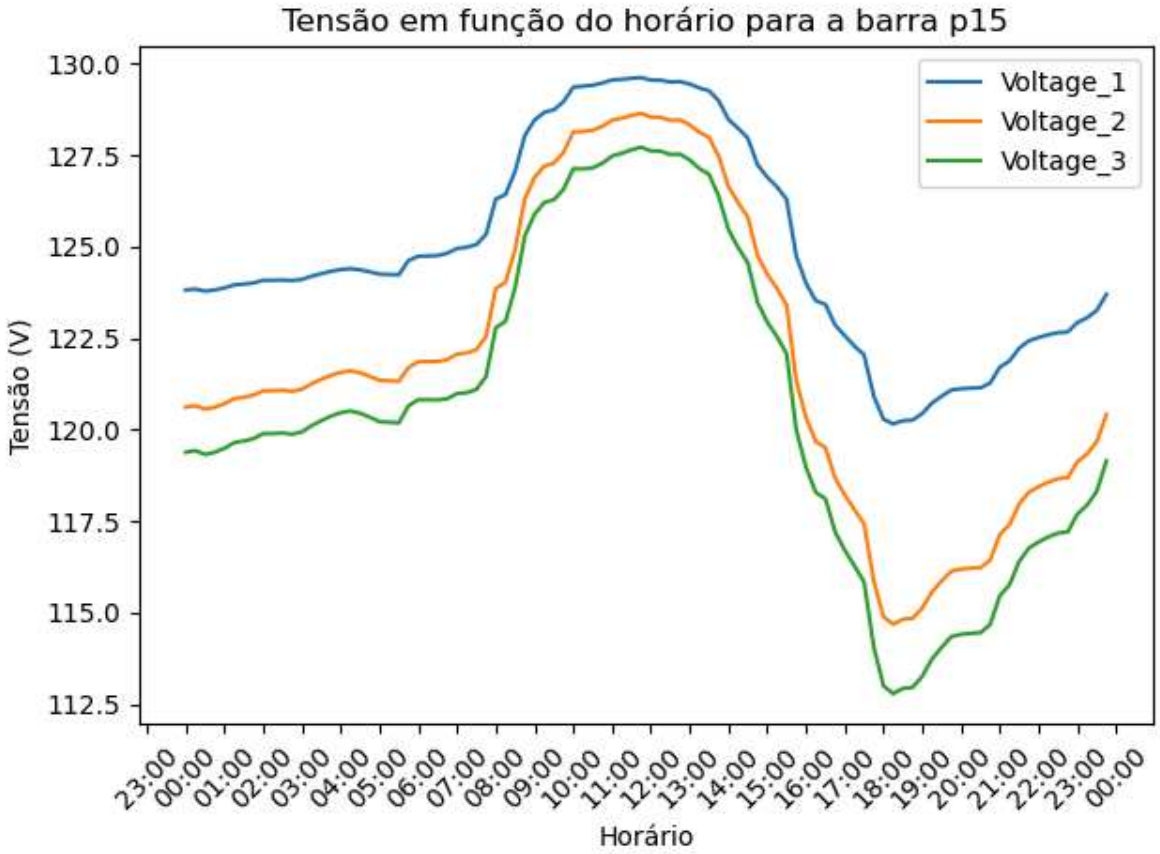

Tensão em função do horário para a barra p10
Voltage_1
Voltage_2
Voltage_3
Tensão (V)
128
126
124
122
120
118
116
114
23:00
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
Horário

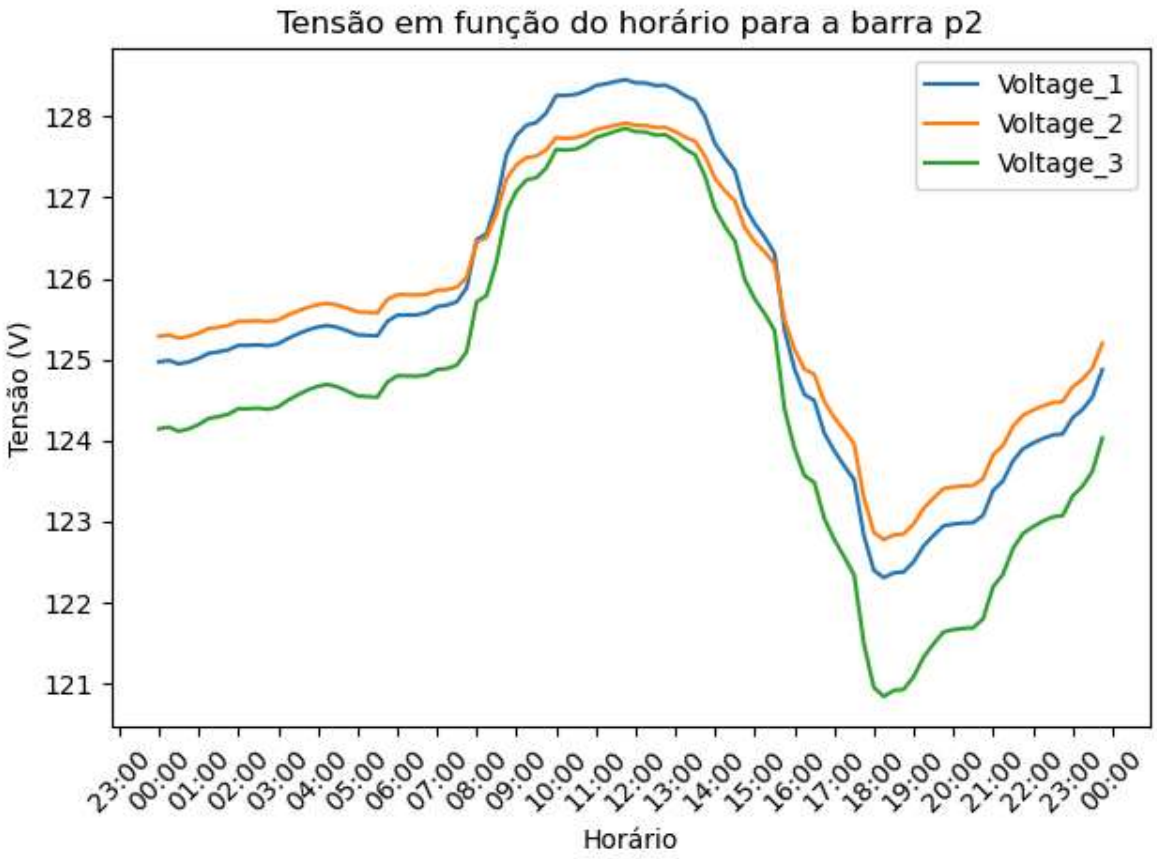

Tensão em função do horário para a barra p11
Voltage_1
Voltage_2
Voltage_3
Tensão (V)
128
126
124
122
120
118
116
114
23:00
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
Horário

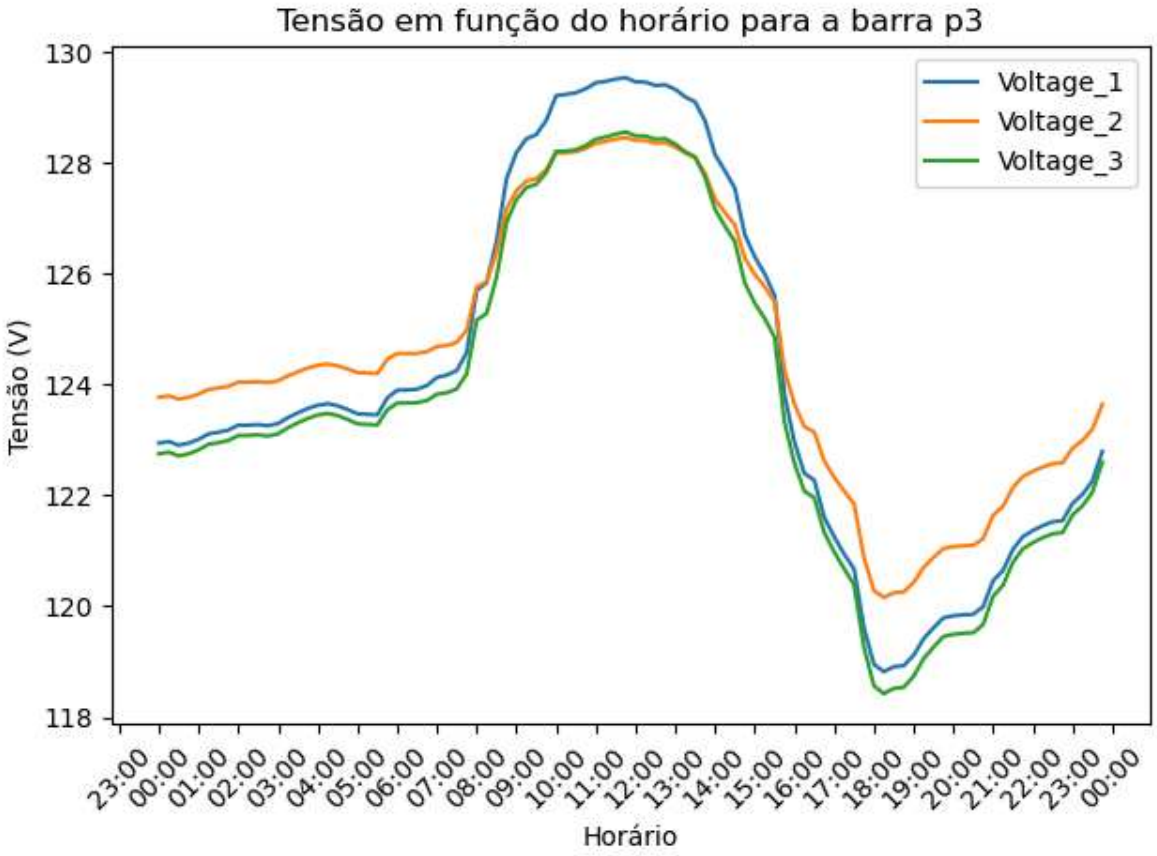

Tensão em função do horário para a barra p12
Voltage_1
Voltage_2
Voltage_3
Tensão (V)
128
126
124
122
120
118
116
23:00
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
Horário

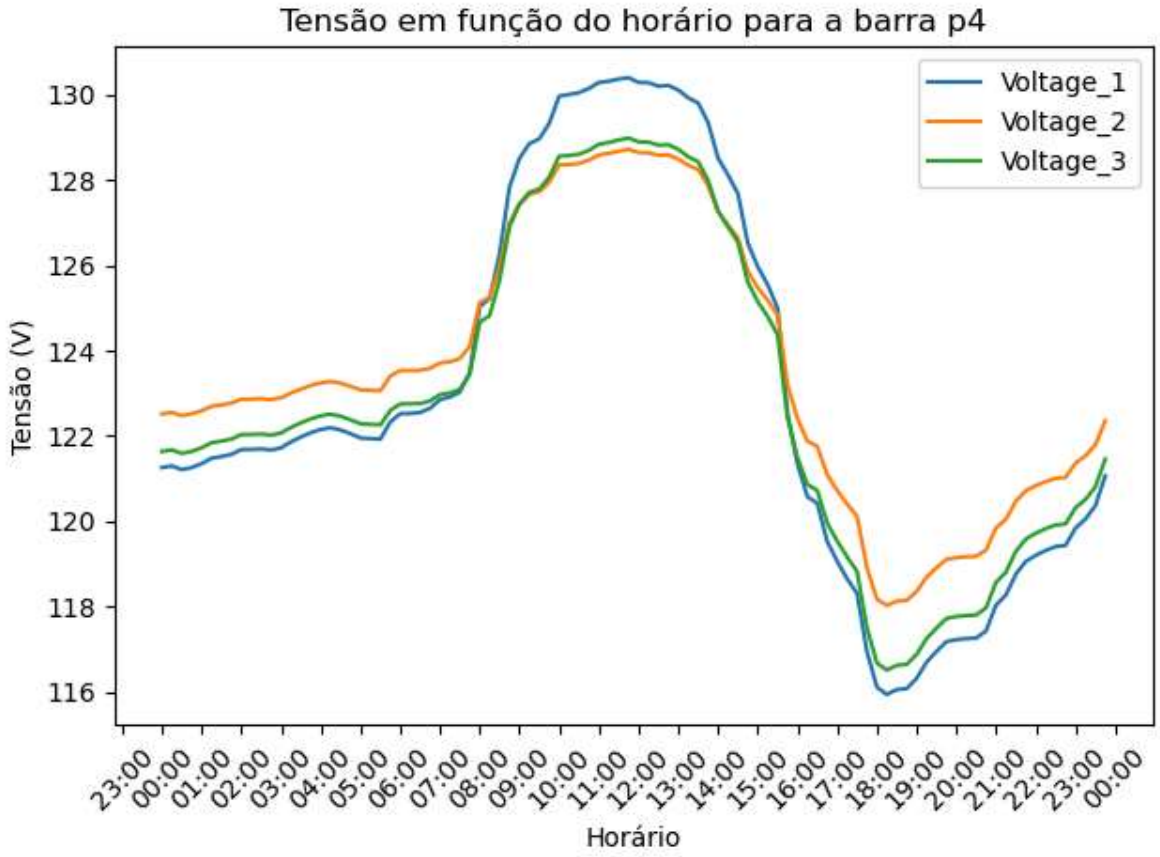

Tensão em função do horário para a barra p13
Voltage_1
Voltage_2
Voltage_3
Tensão (V)
128
126
124
122
120
118
116
23:00
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
Horário

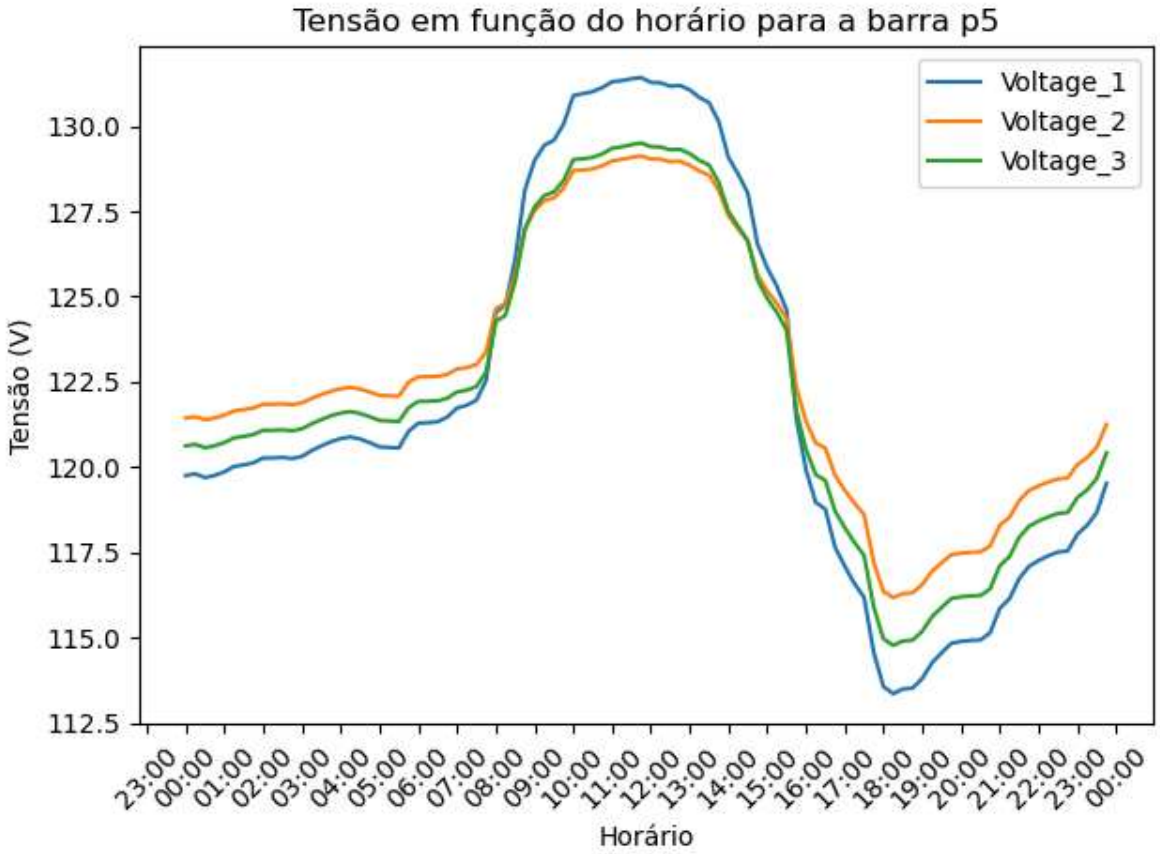

Tensão em função do horário para a barra p14
Voltage_1
Voltage_2
Voltage_3
Tensão (V)
130
128
126
124
122
120
118
116
114
23:00
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
Horário

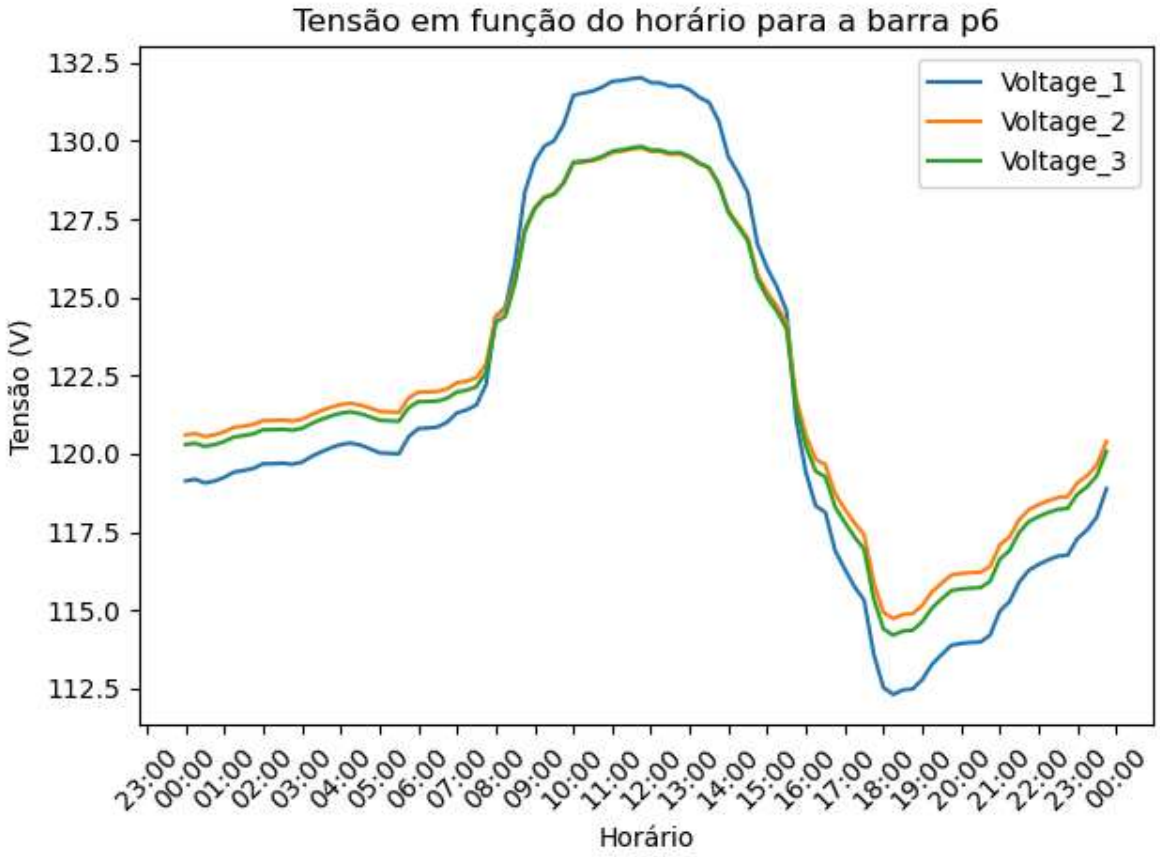

Tensão em função do horário para a barra p15
Voltage_1
Voltage_2
Voltage_3
Tensão (V)
130.0
127.5
125.0
122.5
120.0
117.5
115.0
112.5
23:00
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
Horário

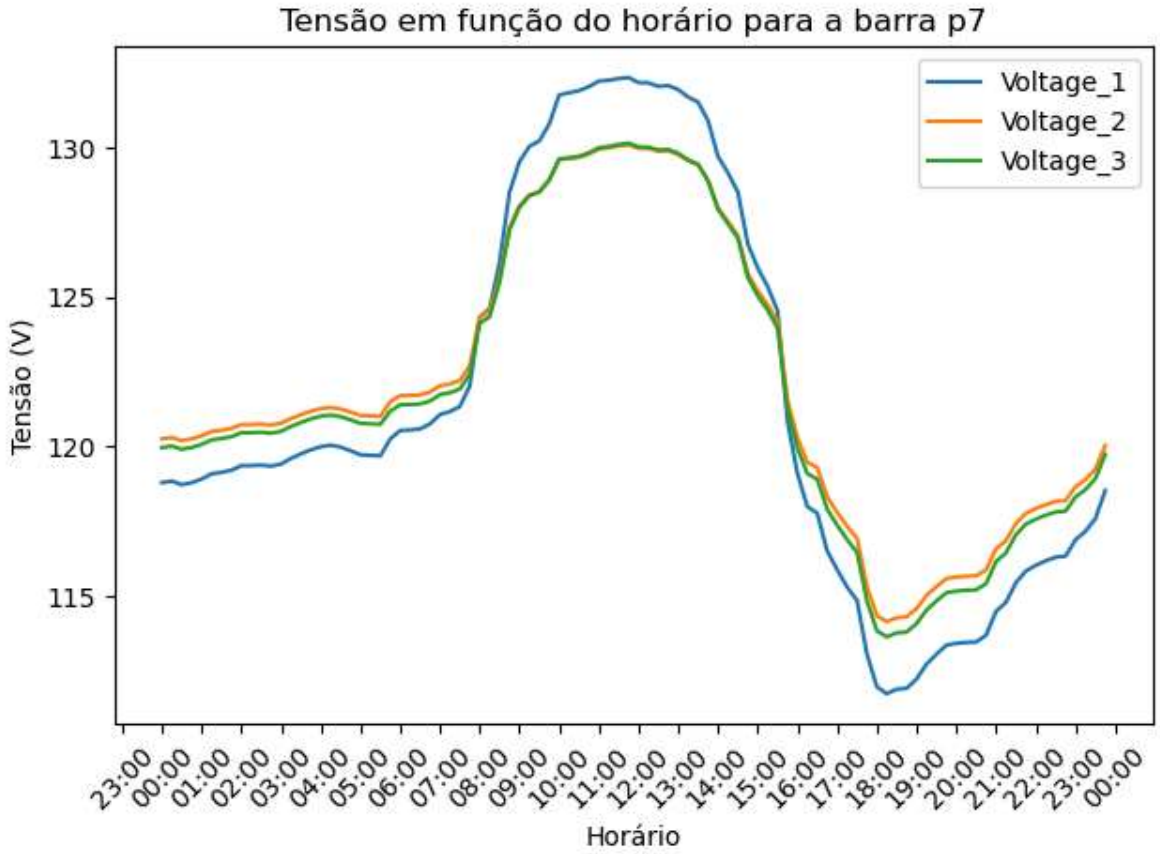

Tensão em função do horário para a barra p2
Voltage_1
Voltage_2
Voltage_3
Tensão (V)
Horário

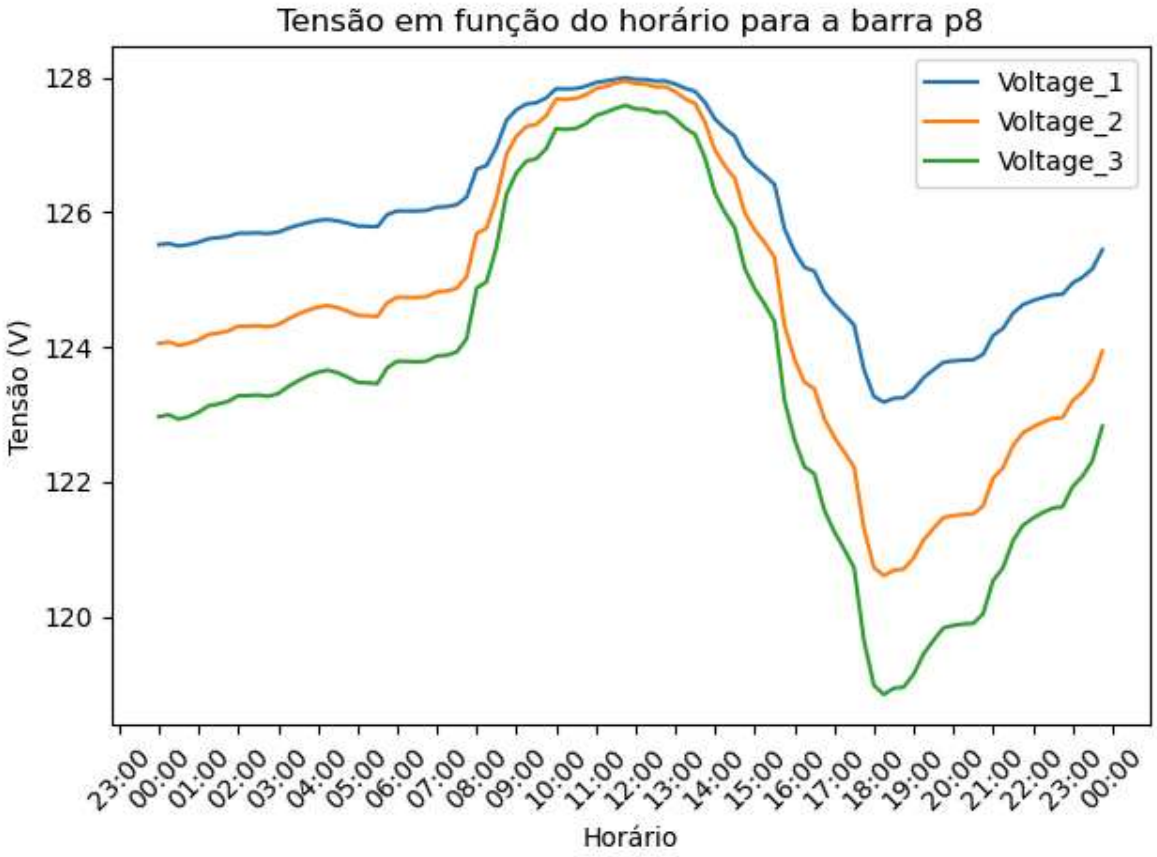

Tensão em função do horário para a barra p3
Voltage_1
Voltage_2
Voltage_3
Tensão (V)
Horário

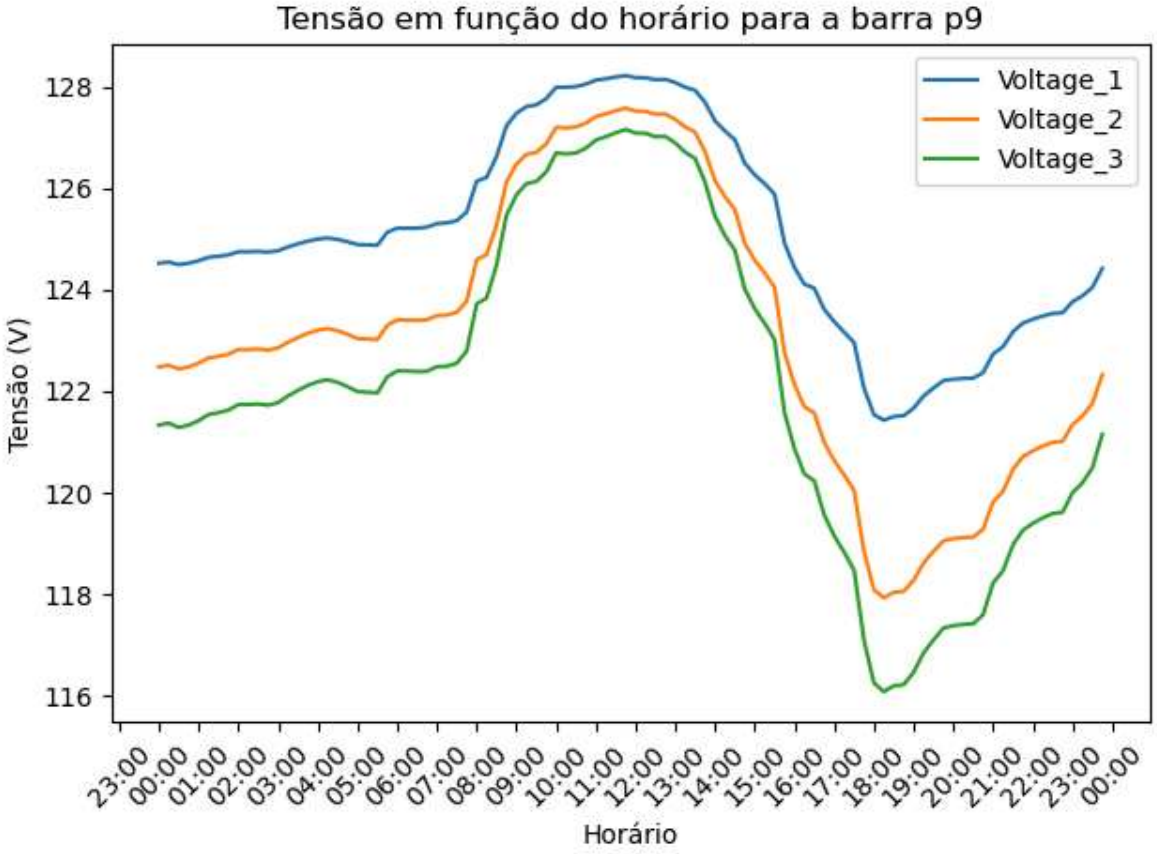

Tensão em função do horário para a barra p4
Voltage_1
Voltage_2
Voltage_3
Tensão (V)
130
128
126
124
122
120
118
116
23:00
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
Horário


Tensão em função do horário para a barra p5
Voltage_1
Voltage_2
Voltage_3
Tensão (V)
130.0
127.5
125.0
122.5
120.0
117.5
115.0
112.5
23:00
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
Horário


Tensão em função do horário para a barra p6
Voltage_1
Voltage_2
Voltage_3
Tensão (V)
132.5
130.0
127.5
125.0
122.5
120.0
117.5
115.0
112.5
23:00
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
Horário


Tensão em função do horário para a barra p7
Voltage_1
Voltage_2
Voltage_3
Tensão (V)
130
125
120
115
23:00
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
Horário


Tensão em função do horário para a barra p8
Voltage_1
Voltage_2
Voltage_3
Tensão (V)
128
126
124
122
120
23:00
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
Horário


Tensão em função do horário para a barra p9
Voltage_1
Voltage_2
Voltage_3
Tensão (V)
128
126
124
122
120
118
116
23:00
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
Horário