The existing and planned transmission system was not sufficient to serve the studied load of 5,372 MW in the Delaware Basin area. In fact, the study case demonstrated voltage instability under N-0 conditions. To identify the long lead time upgrades, which were the primary focus of the study, the reliability issues that would be expected to be addressed through local transmission upgrades were first identified through the steps described below.

## Step 1

With the higher-than-forecasted load (5,372 MW), power flow of the starting case was not solved even if solar generation in the Delaware Basin area (~1,160 MW) was assumed online. The following updates were applied to just make the case solve under the N-0 condition:

* Tapped the new 345-kV Wolf station to the Odessa/Moss - Riverton 345-kV double circuit lines, and add two transformers 345/138-kV transformers at Wolf station (TPIT 46094, Tier 3, Dec 2020)
* Added total 1,860 Mvar reactive devices

Table 1 shows the locations and capacity of these 1,860 Mvar reactive devices. As stated in the study methodology, the focus of this study is to identify long lead time transmission upgrades. The reactive devices will need additional evaluation such as dynamic stability analysis to optimize the sizes, locations, and technology of reactive devices.

Table 1 Locations and Capacity of the Added Reactive Devices

|  |  |  |  |
| --- | --- | --- | --- |
| Bus Number | Bus Name | kV | Capacity (Mvar) |
| 79650 | Clearfork | 345 | 300 |
| 11084 | Riverton | 345 | 300 |
| 21013 | Wolf | 345 | 300 |
| 38124 | Faulkner | 138 | 300 |
| 38065 | Barilla Draw | 138 | 300 |
| 11078 | Coalson Draw | 138 | 250 |
| 11090 | Owl Hills | 138 | 110 |

## Step 2

The upgrades identified in step 1 were able to solve the study base case, and a number of thermal violations which are listed in Table 2 were observed under N-0 condition and solar generation in the study area were assumed online.

Table 2 Thermal Overloads under N-0 with Online Solar Generation in the Delaware Basin Area

|  |  |  |
| --- | --- | --- |
| Element | Length (miles) | Thermal Overloading |
| Wolf Switching Station - Wickett 138-kV ckt 1 | 5.8 | 111.2% |
| Yucca Drive - Royalty 69-kV ckt 1 | 10.3 | 116.2% |
| Royalty - Coyanosa 69-kV ckt 1 | 10.3 | 151.1% |
| Barrilla - Hoefs Road 69-kV ckt1 | 8.2 | 116.1% |
| Barrilla 138/69-kV transformer |  | 111.4% |
| Quail Switch - Odessa EHV Switch 345-kV ckt 1 | 0.9 | 107.9% |
| Riverton 345/138-kV transformer 1 |  | 109.7% |
| Riverton 345/138-kV transformer 2 |  | 109.7% |
| Wink - AA Pipeline Tap 69-kV ckt1 | 0.7 | 121.6% |
| Wickett - Pyote 138-kV ckt 1 | 12.9 | 107.7% |
| Pyote - Reward Tap 138-kV ckt 1 | 12.3 | 103.6% |
| Barilla Draw - Flat Top 138-kV ckt 1 | 5.8 | 124.8% |
| Flat Top - Pig Creek 138-kV ckt 1 | 8.9 | 128.6% |
| Gemsbok - Gemsbok Autonomous Crypto 138-kV ckt 1 | 1.4 | 110.5% |
| AA Pipeline Tap - AA Pipeline Meter Station 69-kV ckt 1 | 0.2 | 103.2% |

To address the thermal overloads listed in Table 2, additional transmission upgrades were identified and added to the study case. Table 3 shows the additional transmission upgrades added in Step 2. The upgrades identified in step 1 and step 2 were needed to address the voltage instability and thermal violations under N-0 condition assuming the solar generation in the study area were online.

**Table 3 Additional Transmission Upgrades in Step 2**

|  |  |
| --- | --- |
| Transmission Upgrades/Addition | Length (miles) |
| Convert AEP 69-kV line Barrilla - Hoefs Road - Verhalen - Saragosa to 138-kV | 33.8 |
| Convert TNMP 69-kV system from Winks to IH20 to 138-kV | (a recent RPG-approved Tier 2 project) |
| Convert ONCOR 69-kV line Yucca - Royalty - Coyanosa - Wolfcamp to 138-kV | 46.9 |
| Tap the Wolf - Riverton 345-kV double circuit at Quarry Field, and add two 345/138-kV transformer at Quarry Field |  |
| Upgrade Quail Switch - Odessa EHV Switch 345-kV ckt 1 | 0.9 |
| Upgrade the Solstice - Hayter - Remeranch 138-kV | 15.7 |

## Step 3

Based on the study assumption, the solar generation in the Delaware Basin area were turned off to represent a stressed system condition. The study results showed that turning off the solar generation in the Delaware Basin area would result in voltage collapse mainly because of the loss of reactive power support from the solar generation. To address the voltage collapse issue, one new single circuit 345-kV import path (Bearkat - Wolf - Sand Lake) was considered as a placeholder project.

The upgrades identified in the abovementioned steps were needed to address the voltage instability and thermal violations under N-0 condition when solar generation in the study area were assumed offline.