

Replacement / Unforeseen Project Summaries

There were no failures or other unforeseen replacement needs on the Energex network, with a value greater than 2 million dollars, during 2020/21.

A complete listing of all committed projects is contained within Appendix D. A summary list of replacement driven projects that have recently been approved with a capital cost of \$2M or greater is shown below.

Table 1 – Projects (>\$2M Replacement) Approved in the Past Twelve Months

| Project Name | Estimated Commissioning |
|--|-------------------------|
| KCY Kilcoy – WFD Woodford - Construction of a new 33kV overhead feeder | 30-Apr-24 |
| NGE Nudgee - Replace 11kV switchgear | 30-Apr-24 |
| BDS Beaudesert - Replace protection relay | 30-Nov-21 |
| SIS Stradbroke Island replace 33/11kV TR3, 33kV bus and CB3T32 | 30-Sep-23 |
| CST Charlotte Street - SACS upgrade & replace DUOBIAS | 31-Mar-23 |
| SPD –Improve backup protection reach & replace obsolete relays | 31-May-24 |
| NGE - Replace 4 x 110kV CBs | 30-Nov-24 |
| MRB Recover 33kV and 11kV outdoor isolators | 30-Mar-24 |
| GLY - Improve 11kV backup protection | 30-Jun-23 |
| MLY Maleny – Rebuild substation to replace ageing assets and uprate transformer capacity | 24-Mar-24 |
| SPO-Improve 11kV backup protection & replace relays | 31-Jan-22 |

Details of replacement driven projects that have been recently approved are shown on the following pages.

Approved Project:**KCY Kilcoy - WFD Woodford – Construction of a new 33kV feeder to replace aged feeder F447****Identified need**

Kilcoy Zone Substation (SSKCY) provides electricity supply to approximately 2,400 predominantly residential customers while also supplying a major industrial customer. SSKCY is normally supplied via 33kV feeder F324 from Woodford Zone Substation (SSWFD). Under contingency, it can also be partially supplied from 33kV feeder F447 from Somerset Dam Zone Substation (SSSDM). These overhead feeders consist of 7/104 Hard Drawn Bare Copper (HDBC) conductors.

Based on a Condition Based Risk Management (CBRM) analysis, the conductors of F447 and F324 have been deemed to reach their retirement age by 2023 and 2026 respectively.

In addition, based on a CBRM analysis, 8 x 33kV isolators, 6 x 11kV isolators, 4 sets of porcelain surge arresters and the 11/0.415kV station service transformer at SSWFD have been deemed to reach their retirement age.

Credible options considered (options considered but rejected are available on request)

- 1) Reconductor F447 (Stage-1) and reconductor F324 (Stage-2).
- 2) Construct a new single circuit (SCCT) 33kV feeder between SSWFD and SSKCY, recover F447 (Stage-1) and reconductor F324 (Stage-2).
- 3) Construct a new double circuit (DCCT) 33kV feeder between SSWFD and SSKCY, recover F447 (Stage-1) and recover F324 (Stage-2).
- 4) Reconductor F447 (Stage-1) and reconductor F324 (Stage-2) and run 3MVA on-site permanent generator at SSKCY.

Other than the above options that have been assessed as meeting the applied service standards, no other practically feasible and economically equivalent network option has been identified in this analysis.

In addition, Energex conducted a Regulatory Investment Test for Distribution (RIT-D) consultation, seeking information regarding alternative potential credible options or variants to the potential credible option (Option 2) presented by Energex. In response, one submission was received. While this identified a technically credible option to establish 10MW of generation at SSKCY, the costs associated with this option were not commercially equivalent to the existing options. As such, no Non-Network Options were identified.

Economic comparison

Energex's planning and NPV analysis have identified that Option 2 is the lowest cost option in 81% of the scenarios considered.

| Rank | Option | Initial Capital Cost* | Net Economic Benefit (NPV relative to Option 2) |
|------|---|-----------------------|---|
| 1 | Construct a new SCCT 33kV feeder SSWFD-SSKCY, recover F447 (Stage-1) and re-conductor F324 (Stage-2) | \$ 34.1m | |
| 2 | Construct a new DCCT 33kV feeder SSWFD-SSKCY and recover F447 (Stage-1) and recover F324 (Stage-2) | \$ 37.9m | -\$4.52m |
| 3 | Reconductor F447 (Stage-1) and reconductor F324 (Stage-2) and run 3MVA on-site permanent generator at SSKCY | \$ 24.2m | -\$6.60m |
| 4 | Reconductor F447 (Stage-1) and reconductor F324 (Stage-2) | \$ 24.2m | -\$60.88m |

* Estimated costs excluding the interest on borrowing. Significant forecasted unserved energy and the resultant Value of Customer Reliability (VCR) costs are associated with options 1 and 4.

Approved Project Cost and Timing

The estimated total project cost is \$23.3m at 2020/21 prices. Construction will occur during the period leading up to the estimated completion date of April 2024.

Impact on Network Charges

This project has been estimated as having an impact on average network charges of 0.0367 ¢/kWh.

Approved Project:

NGE Nudgee - Replace 11kV switchgear

Identified need

Nudgee Zone Substation (SSNGE) supplies approximately 3,000 predominantly residential customers, while also supplying a major customer.

Based on a Condition Based Risk Management (CBRM) analysis, the Westinghouse J18 11kV circuit breakers have been deemed to reach their retirement age by 2021.

In addition, it has been determined that three 11kV feeders from SSNGE do not have sufficient back-up protection reach to isolate certain faults on the 11kV network for a failure of the primary protection.

Credible options considered (options considered but rejected are available on request)

1) Replace 11kV switchgear at SSNGE.

Other than the above option that has been assessed as meeting the applied service standards, no other practically feasible and economically equivalent network option has been identified in this analysis.

In addition to the above, Energex conducted a review of existing and potential non-network opportunities in the area relevant to the network limitation. This review did not identify adequate or less expensive non-network options in the area at this time. The consideration of potential non-network options indicated that proponents may or may not exist in future. Without further evidence, less expensive non-network options are unlikely to occur in the timeframe.

Economic comparison

As there has only been a single credible option identified, no economic comparison has been undertaken.

Approved Project Cost and Timing

The estimated total project cost is \$10.6m at 2020/21 prices. Construction will occur during the period leading up to the estimated completion date of April 2024.

Impact on Network Charges

This project has been estimated as having an impact on average network charges of 0.0166 ¢/kWh.

Identified need

Beaudesert bulk supply substation (SSBDS) provides electricity supply to approximately 11,098 predominantly residential customers in the Beaudesert, Bromelton, Innisplain, Jimboomba and Mt Tamborine areas.

It has been determined that six protection relays will reach their retirement age by 2025. The single dc supply does not meet network protection standards. A second dc system is to be installed.

In addition, one protection relay is to be replaced to improve selectivity for 33kV feeders to Bromelton zone substation (SSBTN). Three protection relays no longer required are to be recovered for spares.

Credible options considered (options considered but rejected are available on request)

1) Replace ageing assets and upgrade dc supply to current standards.

Other than the above options that have been assessed as meeting the applied service standards, no other practically feasible and economically equivalent network option has been identified in this analysis.

In addition to the above, Energex conducted a review of existing and potential non-network opportunities in the area relevant to the network limitation. This review did not identify adequate or less expensive non-network options in the area at this time. The consideration of potential non-network options indicated that proponents may or may not exist in future. Without further evidence, less expensive non-network options are unlikely to occur in the timeframe.

Economic comparison

As there has only been a single credible option identified, no economic comparison has been undertaken.

Approved Project Cost and Timing

The estimated total project cost is \$2.03M at 2020/21 prices. Construction will occur during the period leading up to the estimated completion date of November 2023.

Impact on Network Charges

This project has been estimated as having an impact on average network charges of 0.00320 ¢/kWh.

Approved Project:**SIS Stradbroke Island – Replace 33/11kV TR3,
CB3T32 and 33kV bus****Identified need**

Stradbroke Island Zone Substation (SSSIS) provides electricity supply to approximately 2,200 predominantly residential customers in the Dunwich, Amity Point and Point Lookout areas on North Stradbroke Island.

Based on a Condition Based Risk Management (CBRM) analysis, it has been identified that the 33/11kV transformer TR3, 33kV circuit breaker and 33kV air break switches are reaching or have reached retirement age. It was also identified that the steel structures of the 33kV outdoor air-insulated switchgear are structurally unsound due to heavy corrosion. The deterioration of these structures and primary system assets poses safety risks to staff working within the switchyard, and reliability risk to the customers supplied from SSSIS.

In addition, it has been determined that the oil containment system is in poor condition.

Credible options considered (options considered but rejected are available on request)

1) Replace TR3 and upgrade 33kV bus at SSSIS.

Other than the above option that have been assessed as meeting the applied service standards, no other practically feasible and economically equivalent network option has been identified in this analysis.

In addition to the above, Energex conducted a review of existing and potential non-network opportunities in the area relevant to the network limitation. This review did not identify adequate or less expensive non-network options in the area at this time. The consideration of potential non-network options indicated that proponents may or may not exist in future. Without further evidence, less expensive non-network options are unlikely to occur in the timeframe.

Economic comparison

As there has only been a single credible option identified, no economic comparison has been undertaken.

Approved Project Cost and Timing

The estimated total project cost is \$7.9M at 2020/21 prices. Construction will occur during the period leading up to the estimated completion date of September 2023.

Impact on Network Charges

This project has been estimated as having an impact on average network charges of 0.01247 ¢/kWh.

Identified need

Charlotte Street Zone Substation (SSCST), in the Brisbane Central Business District (CBD), supplies approximately 2,800 predominantly residential customers, while also supplying several major customers.

Due to identified issues on problematic Duobias relays, used for the transformer protection on 3 x 110/11/11kV transformers at SSCST, it has been recommended to replace these relays before their expected end-of-life. In addition, 110kV feeder protection relays on F807, F808 and F7267 have been deemed to have reached their retirement age in 2015.

Credible options considered (options considered but rejected are available on request)

- 1) Replace problematic Duobias relays at SSCST and replace protection relays and upgrade protection on 4 x 110kV feeders.

Other than the above option that has been assessed as meeting the applied service standards, no other practically feasible and economically equivalent network option has been identified in this analysis.

Economic comparison

As there has only been a single credible option identified, no economic comparison has been undertaken.

Approved Project Cost and Timing

The estimated total project cost is \$2.7m at 2020/21 prices. Construction will occur during the period leading up to the estimated completion date of March 2023.

Impact on Network Charges

This project has been estimated as having an impact on average network charges of 0.0043 ¢/kWh.

Approved Project:**SPD Surfers Paradise – Improve back-up protection reach, replace obsolete relays & AFLC unit****Identified need**

Surfers Paradise Zone Substation (SSSPD), in the Gold Coast Central Business District (CBD), supplies approximately 12,800 predominantly residential customers, while also supplying several major customers.

It has been identified that the KBCH transformer diff protection relays and the pre-2005 Argus 1 relays on the 11kV feeders at SSSPD are problematic and prone to failure and must be replaced with current contract relays. Also, the existing transformer diff protection schemes have been deemed to be non-compliant as per NER requirements and needs to be upgraded.

In addition, it has been determined that some of the 11kV feeders from SSSPD do not have sufficient back-up protection reach to isolate phase to phase faults on the 11kV network for a failure of the primary protection.

Credible options considered (options considered but rejected are available on request)

- 1) Replace problematic KBCH relays and upgrade protection schemes, replace Argus 1 problematic relays and duplicate 11kV feeder relays to improve back-up protection reach at SSSPD.

Other than the above option that has been assessed as meeting the applied service standards, no other practically feasible and economically equivalent network option has been identified in this analysis.

Economic comparison

As there has only been a single credible option identified, no economic comparison has been undertaken.

Approved Project Cost and Timing

The estimated total project cost is \$2.9m at 2020/21 prices. Construction will occur during the period leading up to the estimated completion date of May 2024.

Impact on Network Charges

This project has been estimated as having an impact on average network charges of 0.00457 ¢/kWh

Identified need

Nudgee bulk supply substation (SSNGE) provides electricity supply to approximately 39,049 predominantly residential customers in the Eagle Farm, Geebung, Hamilton, Hendra, Nudgee, Nundah and Zillmere areas.

Based on a Condition Based Risk Management (CBRM) analysis, two 145kV oil circuit breakers, two 145kV current transformers and one 33kV voltage transformer have been deemed to reach their retirement age by 2021. An additional two 145kV oil circuit breakers have been deemed to reach their retirement age by 2026.

In addition, it has been determined that one protection relay for circuit breaker is from a problematic batch so must be replaced.

Credible options considered (options considered but rejected are available on request)

1) Replace ageing and problematic assets.

Other than the above options that have been assessed as meeting the applied service standards, no other practically feasible and economically equivalent network option has been identified in this analysis.

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Economic comparison

As there has only been a single credible option identified, no economic comparison has been undertaken.

Approved Project Cost and Timing

The estimated total project cost is \$3.2M at 2020/21 prices. Construction will occur during the period leading up to the estimated completion date of November 2024.

Impact on Network Charges

This project has been estimated as having an impact on average network charges of 0.00505 ¢/kWh.

Identified need

Murrumba Zone Substation (SSMRB) provides electricity supply to 52 predominantly residential customers in the Coal Creek, Esk, Glenn Esk, Lake Wivenhoe, Moombra, Mount Halen, and Murrumba areas.

Based on a Condition Based Risk Management (CBRM) analysis, it has been identified that 5 x 33kV and 7 x 11kV outdoor isolators are braid type, which are known to be problematic. These primary system assets pose safety risks to staff working within the switchyard, and reliability risk to the customers supplied from SSMRB. It was also found that the substation has 1 x 33kV and 2 x 11kV sets of disconnect links, which have been identified as a safety risk.

In addition, it has been identified that there is no designated area to park the mobile substation for a failure of 33/11kV TR1 at SSMRB. Civil works are required to establish a pad that is suitable for the mobile substation and this will take 3-5 days to do. This will result to prolonged interruption to supply for essential customers and lead to the Safety Net requirements (Customer Outcome Standards) not being met.

Credible options considered (options considered but rejected are available on request)

- 1) Recover braid-type air-break switches, disconnect links and reclosers. This also involves recovering the 33kV and 11kV outdoor bus, establishing a 33kV strung bus with pole mounted reclosers, two 11kV ground mounted reclosers and provision for a mobile substation parking and connection.

Other than the above option that have been assessed as meeting the applied service standards, no other practically feasible and economically equivalent network option has been identified in this analysis.

Economic comparison

As there has only been a single credible option identified, no economic comparison has been undertaken.

Approved Project Cost and Timing

The estimated total project cost is \$3.7M at 2021/22 prices. Construction will occur during the period leading up to the estimated completion date of March 2024.

Impact on Network Charges

This project has been estimated as having an impact on average network charges of 0.00589 ¢/kWh.

Approved Project:**GLY Grovely – Improve 11kV backup protection reach****Identified need**

Grovely Zone Substation (SSGLY) provides electricity supply to approximately 8,400 predominantly residential customers in the Ferny Grove, Keperra, Mitchelton and Upper Kedron areas. Arana Hills Zone Substation (SSAHL) provides electricity supply to approximately 13,600 predominantly residential customers in the Albany Creek, Arana Hills, Bridgemen Downs, Bunya, Everton Hills, Everton Park, Ferny Grove, Ferny Hills, Keperra, McDowall and Mitchelton areas.

It has been determined that all 11kV feeders from SSGLY do not have sufficient back-up protection reach to isolate phase to phase faults on the 11kV network for a failure of the primary protection.

In addition, it has been determined that SSGLY has 2 transformer ended 33kV feeders with intertripping installed on a single communications path to clear transformer faults. Loss of communications prevents a transformer fault intertripping the source. Following recent 33kV outages to SSAHL, it was also identified that due to the existing 33kV network and protection configuration, this section of network is not able to readily and reliably supply customer load during a contingency event. As such, it is prudent to upgrade this section of the 33kV network in order to reduce the financial burden that outages place on customers.

Credible options considered (options considered but rejected are available on request)

- 1) Duplicate 11kV feeder protection to improve 11kV feeder back-up protection reach at SSGLY, install dual diverse protection & communications on 33kV feeder F595 and 33kV feeder F596, and upgrade the local 33kV network supplying SSGLY and SSAHL.

Other than the above options that have been assessed as meeting the applied service standards, no other practically feasible and economically equivalent network option has been identified in this analysis.

Economic comparison

As there has only been a single credible option identified, no economic comparison has been undertaken.

Approved Project Cost and Timing

The estimated total project cost is \$3M at 2021/22 prices. Construction will occur during the period leading up to the estimated completion date of June 2023.

Impact on Network Charges

This project has been estimated as having an impact on average network charges of 0.00470 ¢/kWh.

Approved Project:**MLY Maleny – Rebuild substation to replace ageing assets and uprate transformer capacity****Identified need**

- 1) Maleny Zone Substation (SSMLY) provides electricity supply to approximately 4,200 predominantly residential customers.
- 2) Based on a Condition Based Risk Management (CBRM) analysis, 33kV (duro roll) and 11kV (braid-type) problematic disconnectors have been deemed to reach their retirement age by 2022. In addition, a civil condition assessment has identified a number of further issues including the poor condition of the outdoor bus pipework structures due to corrosion, unreliable operation of the transformer oil-containment system and the poor condition of the control building. Furthermore, based on the current load forecast, the 50 PoE load at SSMLY is forecast to exceed the 2HEC in winter 2022.

Credible options considered (options considered but rejected are available on request)

- 1) Rebuild substation to replace aging assets and uprate transformer capacity

Other than the above option that has been assessed as meeting the applied service standards, no other practically feasible and economically equivalent network option has been identified in this analysis.

In addition to the above, Energex conducted a review of existing and potential non-network opportunities in the area relevant to the network limitation. This review did not identify adequate or less expensive non-network options in the area at this time. The consideration of potential non-network options indicated that proponents may or may not exist in future. Without further evidence, less expensive non-network options are unlikely to occur in the timeframe.

Economic comparison

As there has only been a single credible option identified, no economic comparison has been undertaken.

Approved Project Cost and Timing

The estimated total project cost is \$13.7m at 2021/22 prices. Construction will occur during the period leading up to the estimated completion date of March 2024.

Impact on Network Charges

This project has been estimated as having an impact on average network charges of 0.0216 ¢/kWh.

Approved Project:**SPO Southport – Improve back-up protection reach, upgrade transformer protection scheme, battery & DC system****Identified need**

South Port Zone Substation (SSSPO), in the Gold Coast Central Business District (CBD), supplies approximately 21,600 predominantly residential customers, while also supplying several major customers.

It has been identified that the Duobias transformer diff protection relays at SSSPO are problematic and prone to failure and must be replaced with current contract relays. Also, the existing transformer protection schemes have been deemed to be non-compliant as per NER requirements and need to be upgraded.

In addition, it has been determined that some of the 11kV feeders from SSSPO do not have sufficient back-up protection reach to isolate phase to phase faults on the 11kV network for a failure of the primary protection.

Credible options considered (options considered but rejected are available on request)

- 1) Replace problematic Duobias relays and upgrade protection scheme, battery & DC system at SSSPD.

Other than the above option that has been assessed as meeting the applied service standards, no other practically feasible and economically equivalent network option has been identified in this analysis

Economic comparison

As there has only been a single credible option identified, no economic comparison has been undertaken.

Approved Project Cost and Timing

The estimated total project cost is \$2.5m at 2020/21 prices. Construction will occur during the period leading up to the estimated completion date of August 2023.

Impact on Network Charges

This project has been estimated as having an impact on average network charges of 0.00393 ¢/kWh