Capital/Revenue Investment Proposal – Summary

**New York Transmission Oil Circuit Breaker Replacement Strategy**

**Niagara Mohawk Power Co: 36 , Project No. C37883 (DxT)**

**Niagara Mohawk Power Co: 36 , Project No. C37882 (TxT)**

(A strategy paper by Kelley Csizmesia and sponsored by Paul Renaud – November 2010)

**Description**

The scope of this strategy is to replace eighty seven oil circuit breakers on the Transmission system in New York over a period of ten years. This strategy proposes an investment of $44m in the range $33m to $66m over that period. The drivers for the strategy are declining condition, obsolescence and the need to reduce the likelihood of safety or environmental issues that could result from the failure of a large oil volume circuit breaker.

The replacement of problematic, poor condition, large oil volume circuit breakers with modern, low maintenance $SF_6$ circuit breakers will improve reliability and reduce lifetime operating costs. The circuit breakers addressed in this strategy are obsolete, in a state requiring replacement, and have limited spare parts or manufacturer support.

The benefit to customers as a result of this strategy is a reduction in the occurrence of outages caused by either failure to operate or the catastrophic failure of poor condition circuit breakers.

Cost estimates for this strategy rely on several completed projects as well as conceptual engineering estimates. An average of $0.5m per circuit breaker replacement was used to develop this strategy. Sanctioning will be done annually. See Appendix 1 for proposed replacement years and locations.

Category: **Policy-driven**

Spending Rationale: **Asset Condition**

Risk score: FY13 thru FY16 targeted replacements **35, Reliability**
FY17 thru FY19 targeted replacements **28, Reliability**
FY20 thru FY22 targeted replacements **26, Reliability**

**Finance**

Cost - $44m, $33m to $66m

Probability that project cost will exceed applicable $ range: - **N/A**

Project included in approved Business Plan? - **Yes**

Project cost relative to approved capital Business Plan – **(1.46m)**

If cost > approved B Plan how will this be funded? – **N/A**

Other financial issues: NA

| $m | Current planning horizon | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Yr 1 FY11/12** | **Yr 2 FY12/13** | **Yr 3 FY13/14** | **Yr 4 FY14/15** | **Yr 5 FY15/16** | **Yr 6+** | ***Total*** | ***Lower Range P20*** | ***Upper Range P80*** |
| **Capex investment** | .5 | 3.88 | 4.37 | 4.37 | 4.37 | 25.22 | 42.7 | n/a | n/a |
| **Opex** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | n/a | n/a |
| **Cost of Removal** | 0 | .12 | .14 | .14 | .14 | .78 | 1.32 | n/a | n/a |
| **Totals:** | .5 | 4.0 | 4.5 | 4.5 | 4.5 | 26.0 | 44.0 | n/a | n/a |

| $m | FY 11/12 | FY 12/13 | FY 13/14 | FY 14/15 | FY 15/16 | YR 6+ | Total |
|---|---|---|---|---|---|---|---|
| Co: 36 (DXT) | 0.25 | 0.00 | 2.00 | 1.00 | 0.00 | 5.00 | 8.25 |
| Co: 36 (TXT) | 0.25 | 4.00 | 2.50 | 3.50 | 4.50 | 21.00 | 35.75 |
| Total | 0.50 | 4.00 | 4.50 | 4.50 | 4.50 | 26.00 | 44.00 |

**Resources**

Availability of internal resources to deliver project: **Green**

Availability of external resources to deliver project: **Green**

Operational impact on network system: **Green**

**Key issues**

- Deteriorated assets and poor performance
- Sanctioning will be done annually. See Appendix 1 for proposed replacement years and locations.

| Milestone | Target Date: Month/Year |
|---|---|
| **Start Preliminary Engineering (kick-off meeting)** | **March 2011** |
| **Sanction** | **Sanctioned annually FY12 thru FY22 (see Appendix 1)** |
| **Engineering Design Complete - EDC** | **Various** |
| **Construction Start** | **Various** |
| **Construction Complete - CC** | **Various** |
| **Ready for Load - RFL** | **N/A** |
| **Project Closure Report** | **March 2022** |

**Climate change**

Contribution to National Grid's 2050 80% emissions reduction target: **slightly negative**

Impact on adaptability of network for future climate change: **Neutral**

Are financial incentives (e.g. carbon credits) available? **No**

**Prior sanctioning history including relevant approved Strategies**

**None**

**Recommendations**

The Transmission Investment Committee is invited to:

(a) ENDORSE the investment of $**44**m in the range $**33**m to $**66**m for completion by **March 2022**

(b) NOTE that a preliminary Works Sanction for the approval of $0.5m for preliminary engineering will be submitted upon endorsement of this strategy for FY13 construction.

(c) NOTE that **Paul Renaud** is the Project Sponsor

(d) NOTE that **Daniel Glenning** is the Project Manager.

Signature........................ Date 12/13/10

Paul Renaud, Vice President Transmission Asset Management

**Decision of the Transmission Investment Committee**

I hereby approve the recommendations made in this paper.

Signature........................ Date 12/17/10

Nick Winser, Group Director UK & US Transmission
on behalf of the Transmission Investment Committee

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**New York Transmission Oil Circuit Breaker Replacement Strategy**

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**Niagara Mohawk Power Co: 36 , Project No. C37882 (TxT)**

(A strategy paper by Kelley Csizmesia and sponsored by Paul Renaud – November 2010)

## 1. Background

1.1. This strategy paper proposes the replacement of three 345kV, nine 230kV and seventy-five 115kV large volume oil circuit breakers (87 in total) on the Transmission system in New York over a ten year period. (See Appendix 1 for locations). The estimated outturn cost to deliver this strategy is $44m, in the range $33m to $66m. Sanctioning will be done annually. See Appendix 1 for proposed replacement years and locations.

1.2. There are 711 circuit breakers installed on the Transmission system in New York, of these, 376 are large oil volume types. Based on asset condition and performance, 180 of these large volume oil circuit breakers are classified as high replacement priorities.

1.3. The majority of the 87 circuit breakers addressed in this strategy were installed between 1948 and 1969, are in poor condition or are the last remaining members of problematic families. The remaining 93 high replacement priority oil circuit breakers on the system are currently either planned for replacement or will be replaced due to station rebuild requirements or planning needs such as increased short circuit duty or load growth.

1.4. A trouble report history of oil circuit breakers in New York can be found in Appendix 2. There were a total of 886 trouble reports documented from 2005 through Aug 2010 (average of 2.4 trouble reports per breaker).

350 (40%) of these trouble reports were directly related to the 87 Oil Circuit Breakers proposed for replacement in this paper.

The table clearly shows an increasing trend of problems associated with the large volume oil circuit breaker population in New York. Common problems include:

- Oil leaks, air leaks, bushing hot spots, high power factors and poor insulation
- Failures of; pressure valves, hoses, gauges, motors, compressors, pulleys, o-rings, control cables, trip coils, close coils, lift rods and contacts

1.5. The following circuit breaker types are ranked the highest priority for replacement by Substation O&M Services;

- **Allis Chalmers Type BZO –** The operating mechanisms in this family of breakers, manufactured in the 1950s through 1980s, are showing an increase in accumulator pump and o-ring failures. Design changes and changes in component manufactures over the years require different replacement parts for various vintages and these parts are difficult to obtain. Mechanism wear has resulted in reduced levels of reliability, increased maintenance costs and a number of failures. There are currently 109 Allis Chalmers Type BZO circuit breakers installed on the New York system.

- **Westinghouse GM -** Test results from this family of breakers indicate contact timing problems and questionable insulation integrity. There are currently 38 Westinghouse GM circuit breakers installed on the New York system.

- **General Electric Type FK –** There have been problems with bushing oil leaks and lift rods issues due to moisture ingress with these circuit breakers. In addition lead paint is prevalent in this family of breakers. There are currently 115 General Electric Type FK circuit breakers installed on the New York system.

1.6 Common to all of these breaker families is the lack of manufacturer support and the inability to locate replacement parts. In some cases these breakers are kept in service using salvaged second hand parts from retired equipment. This situation is not sustainable and a planned replacement approach is required.

1.7 Due to outage coordination, it is becoming increasingly difficult to get the circuit breakers out of service to address these issues.

1.8 The replacement of poor condition oil circuit breakers with modern SF6 gas circuit breakers will improve reliability, reduce lifetime operating costs and reduce the volume of oil at substations.

1.9 The Step 0 meeting was held Monday September 27, 2010. Discussion included the need to review current substation rebuild timeframes to ensure highest replacement priority circuit breakers were addressed in the near future. Concerns regarding this were due to station rebuilds being pushed out to later years.

Also discussed was the necessity to be clear on replacement approach regarding engineering, sanctioning and coordination with other substation projects.

## 2. Driver

### Reliability

2.1 Due to the key function carried out by circuit breakers, particularly for fault clearance, they cannot be allowed to become unacceptably unreliable. As such all circuit breakers should be replaced prior to the earliest onset of significant unreliability. The average age of oil circuit breakers in New York is 43 years. Approximately two percent are greater than 60 years old and 59 percent of the total population is between 40 and 59 years old. The typical expected life for oil circuit breakers is 45 years.

2.2 Examples of Oil Circuit Breakers failures in New York include;

- 2000: Ash St Station; GE FK -115 oil circuit breaker R8205
- 2002: Union Station; GE FK oil circuit breaker R350
- 2003: Rotterdam Station; FP RHE -84-10000 230KV oil circuit breaker R84
- 2003: Dunkirk Station; GE FK-115 oil circuit breaker R252
- 2003: Lockport Station; AC-BZO-115-10000 oil circuit breaker R213
- 2005: [redacted] Station; AC-BZO-115-10000 oil circuit breaker R100
- 2005: Rotterdam Station; FP RHE -84-10000 230KV oil circuit breaker R82
- 2007: Schuyler Station; GE FK-115 oil circuit breaker R130
- 2008: Schuyler Station; GE FK-115 oil circuit breaker R210

2.3 The planned replacement of these circuit breakers reduces the likelihood of an in-service failure which can lead to long-term interruptions of the transmission system as well as significant customer outages. This circuit breaker replacement strategy offers National Grid the opportunity to improve the reliability performance of the transmission network in terms of CAIDI and SAIFI.

**Safety**

2.4 As these circuit breakers continue to wear the likelihood of them failing to operate correctly during fault interruption is increasing. National Grid has already experienced failures of oil circuit breakers within the transmission system in both New England and New York. Such failures at these high voltages have the potential to be extremely dangerous resulting in erratic voltage dissipation, flying debris and the possibility of injury to site personnel. In addition, adjacent equipment is often damaged further increasing the risk of equipment failure, fire and injury.

**Environmental**

2.5 Typical large oil volume circuit breakers contain 800+ gallons of oil and the failure of a bulk oil circuit breaker could result in the release of oil into local water courses. Unlike transformers, oil filled circuit breakers are not provided with oil containment arrangements. Incidents have occurred where the force resulting from the circuit breaker failure was powerful enough to rupture the tank causing extensive and costly environmental clean up.

## 3. Strategy Description

3.1 The scope of this strategy is to purchase and install three 345kV, nine 230kV and seventy-five 115kV SF6 gas circuit breakers over a 10 year period at the locations and proposed timeframes listed in appendix 1.

3.2 Additionally, where cost effective and where their condition warrants, the opportunity will be taken to replace disconnects, control cable and other equipment associated with these circuit breakers to ensure future reliability.

3.3 This proposal includes the material, labor and engineering cost to replace eighty-seven bulk oil circuit breakers with gas circuit breakers on the Transmission system in New York.

3.4 Per National Grid Policy, this strategy will be reviewed on an annual basis to provide the necessary assurance that:

- The approach is correct.
- There is still a valid need to proceed.
- If any underlying data, models or assumptions are deemed to have changed significantly then a revision to this strategy will be submitted.

3.5 Risk scoring and replacement priorities will also be reevaluated annually.

3.6 Future review/revision of the strategy will be the responsibility of Transmission Asset Strategy.

## 4. Business Issues

4.1 This strategy is consistent with National Grid's goal of complying with NERC & NPCC reliability criteria and improving reliability for the benefit of our customers. National Grid will benefit through reduced financial penalties associated with poor reliability.

4.2 Failure to replace these circuit breakers in a programmatic way leaves National Grid open to the exposures identified above.

4.3 Executing this strategy will also improve operations by removing obsolete and problematic assets from the transmission system.

4.4 This strategy addresses Asset Management goals by removing obsolete and problematic assets from the transmission network.

## 5. Options Analysis

5.1 **Option1 – Do Nothing**. This option would have no initial cost however there will be indirect costs associated with increased maintenance levels. This option would involve no proactive replacement of equipment, only replacing when failure occurs. This option is unacceptable because;

- Leaving degraded circuit breakers in service puts the company and customers at risk of long-term interruptions of the transmission system.
- Violent failures of this equipment have the potential to cause extensive damage to other equipment as well as serious injuries to our employees.

All circuit breakers should be replaced before the onset of significant unreliability.

5.2 **Option 2 – Refurbishment**. This option would be to undertake a major refurbishment as opposed to replacement. This option would involve the disassembly of the majority of the circuit breaker components. These components would need to be refurbished back to original design tolerances. Also replacement of any worn out or degraded parts would need to be acquired. Because of a lack of Manufacturer support and inability to locate replacement parts this option is likely to be more costly. In addition, refurbishment may only provide a few years of additional life. Refurbishment is a one-off activity and cannot be repeated indefinitely but refurbishment may have limited application where it is not possible to replace the circuit breakers due to outage or other constraints.

5.3 **Option 3 – postpone replacement for up to 5 years.** This option will defer replacement of the high replacement priority large oil volume circuit breaker population for up to 5 years. There is evidence of deterioration through known failure mechanisms and in some cases circuit breakers are being kept in-service using salvaged second-hand parts from retired equipment. This approach is not considered sustainable. Without investment in the next five years likelihood and consequences (long term interruptions & violent failures) as stated in option 1 would increase.

This option is not acceptable given the current asset conditions. Circuit breaker reliability, already at low levels, will continue to degrade as assets in poor condition continue to deteriorate.

5.4 **Option 4 – planned replacement (recommended).** This recommended option would involve replacing 87 large oil volume circuit breakers in New York over the next ten years. This will eliminate the risks of unwanted outages, safety and environmental concerns associated with equipment failure and replace assets on the system that are in a state requiring replacement.

## 6. Milestones

6.1 The strategy would be executed over a ten year period with installation commencing in 2013.

6.2 Step 0 meetings will be initiated for all of the sites listed in Appendix 1 to identify the full scope of work required.

6.3 Sanctioning will be done annually. See Appendix 1 for proposed replacement years and locations.

6.4 To gain efficiencies, circuit breaker installation will be undertaken coincident with other construction activities.

## 7. Safety, Environmental and Planning Issues

7.1 In some areas, nearby transmission and distribution lines will still be energized. The importance of maintaining appropriate working clearances from nearby energized lines will be emphasized with all personnel involved with the execution of this strategy.

7.2 This equipment exists in established substation locations. This work will generally be exempted from environmental permitting.

7.3 Excepting unforeseen issues, there are no other external approvals or conditions expected.

7.4 As this is a multi-year strategy, construction strategy and outage requirements will be addressed at the sanction level.

## Investment Recovery

## 8. Investment Classification and Recovery

8.1 This strategy is completely driven by internal policy. Specifically the Asset Management policy to provide a safe, efficient and reliable operation, to manage the risks associated with our activities and to deliver improvements through effective asset management.

8.2 **Niagara Mohawk Power Corporation**
Niagara Mohawk's bundled delivery rates for T&D in New York are currently fixed within a 10-yr rate plan that was set to expire on December 31, 2011. In January 2010, Niagara Mohawk filed a proposal to revise the fixed cost recovery levels effective January 1, 2011. Embedded in both the current and proposed rates are fixed levels of annual capital investment recovery. To the extent the annual capital projects are within the capital program forecast allowed in the rate plan, the company recovers the associated costs.

**Regulatory Implications**

8.3 This investment has no affect on National Grid US license and/or regulatory obligations.

## 9. Customer Impact

9.1 A number of the sites in Appendix 1 have directly connected customers / generators. Detailed plans will be developed during preliminary engineering to minimize any disruption to their operations. On approval of this strategy, contact will be made with these customers to inform them of our plans and to discuss mutually acceptable timescales. The installation of modern gas circuit breakers in replacement of aging and problematic bulk oil circuit breakers will lead to improved reliability performance providing our customers with improved service. Planned replacement also offers the lowest lifetime cost approach for customers.

9.2 Planned replacement offers the lowest lifetime cost approach for customers.

**Financial Impact**

## 10. Cost Summary

10.1 The estimated (conceptual engineering grade -25/+50%) cost to implement this strategy is as follows:

| | | Current planning horizon | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $m | Yr 1 FY11/12 | Yr 2 FY12/13 | Yr 3 FY13/14 | Yr 4 FY14/15 | Yr 5 FY15/16 | Yr 6+ | *Total* | *Lower Range P20* | *Upper Range P80* |
| Capital Investment | Proposed Sanction | .5 | 3.88 | 4.37 | 4.37 | 4.37 | 25.22 | 42.7 | n/a | n/a |
| | Capital plan | .05 | .9 | 6.0 | 8.0 | 4.0 | 0 | 18.95 | | |
| | Variance to plan | .45 | 2.98 | (1.63) | (3.63) | .37 | 25.22 | 0 | | |
| | Unit cost allowance | NA | NA | NA | NA | NA | NA | NA | | |
| O&M | Proposed Sanction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Removal | Proposed Sanction | 0 | .12 | .14 | .14 | .14 | .78 | 1.32 | | |
| | Totals: | .5 | 4.0 | 4.5 | 4.5 | 4.5 | 26.0 | 44.0 | | |

## 11. Cost Assumptions

11.1 Cost estimates rely on several completed projects as well as conceptual engineering estimates. An average of .5m per circuit breaker replacement was used to develop this strategy.

## 12. NPV

12.1 Not financially driven

## 13. Additional Impacts

13.1 There is no depreciation or early asset write-offs associated with this strategy. There will be a small reduction in OPEX resulting from reduced maintenance and repair costs.

13.2 There are no forecast increases in O&M costs associated with the installation of the new gas circuit breakers.

## 14. Execution Risk Appraisal

14.1 As this is a multiyear strategy, there is a more significant exposure regarding increases in material, construction and engineering costs. Any significant increases in these costs could cause the strategy estimates to be exceeded. These risks are best mitigated by review and revision of the strategy. This is expected to occur annually per National Grid Policy.

14.2 This strategy covers multiple locations. Since it is not feasible to complete all conceptual engineering prior to the completion of the strategy paper, there is a risk that preliminary engineering may uncover significant unforeseen problems in replacing the identified circuit breakers. This risk would be mitigated in part by sanctioning the strategy on an annual basis.

14.3 There is a risk that a circuit breaker may fail prior to its replacement. This could happen whether or not the strategy is completed on time. This would result in unacceptable customer outages. If this strategy is not delivered according to schedule, these risks will increase.

14.4 System conditions could impact the outage scheduling of individual installations but overall completion of all installations within the 10 Year period should be achievable.

## 15. Statements of Support

15.1 Authors of this paper assure that in accordance with TGP 11 the supporters listed below have been consulted and that each function listed below supports this paper.

**Supporters**

Director – Transmission Investment Management – Tom Sullivan
Director – Transmission Planning – Carol Sedewitz
Director – Transmission Asset Strategy - Alan Roe
Director – Transmission Commercial Services – Bill Malee
Director – Transmission Finance – Steve Bern
Director – Regulatory Strategy - Peter Zschokke
Director – Project Management. – Dan Glenning
Director – Substation Engineering - Don Angell
Director – Protection and Meter Engineering - Bryan Gwyn
Director – Internal Construction - Fred Raymond
Director – External Construction – Jeff Faber
Director – N.Y. Control Center Mike Schiavone
Manager – Project Management N.Y. – Lorraine Barney
Manager – Program Management N.Y. – Mark Phillips

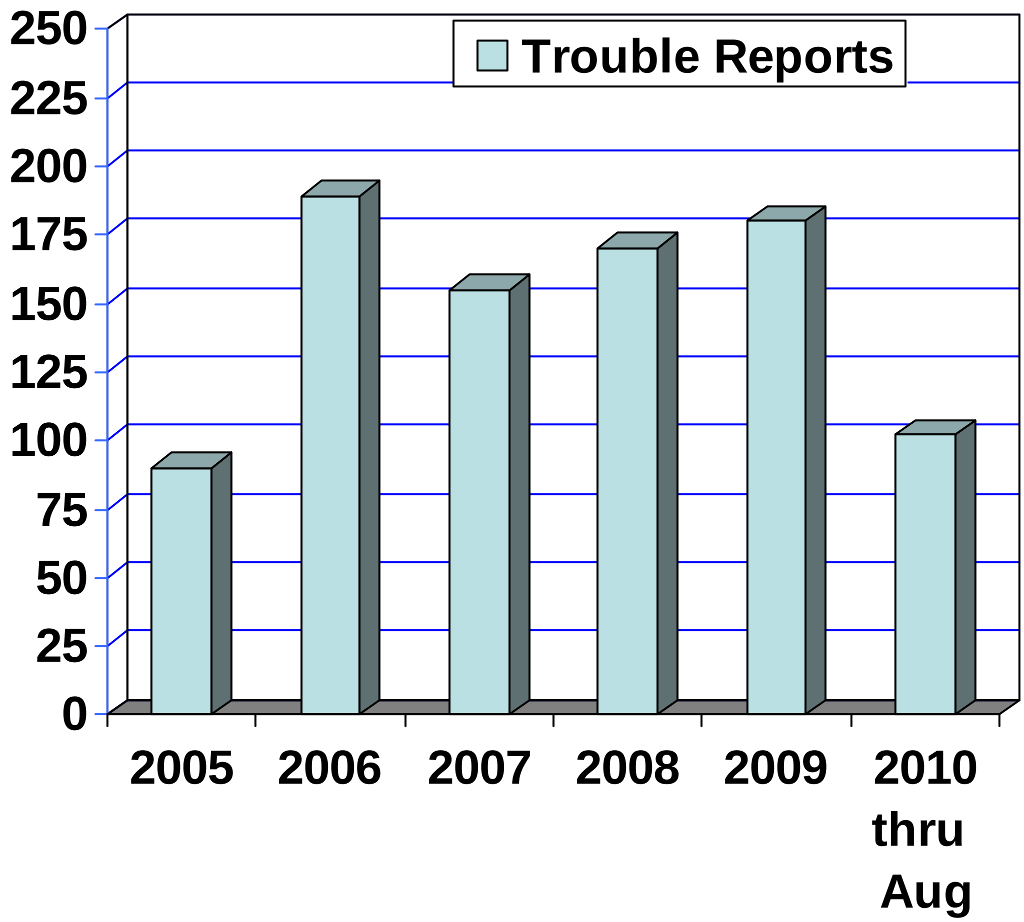
## Appendix 1

| Station_Name | OP_Desc | Manuf | Mfr_Type | Mfr_Date | Station_No | FERC | Func | kV | Proposed Year |
|---|---|---|---|---|---|---|---|---|---|
| Browns Falls Station 711 | R40 | WE | GM-4 | 01/01/1948 | NY08-0610 | T | T | 115 | FY13 |
| Browns Falls Station 711 | R10 | WE | GM-4 | 01/01/1948 | NY08-0610 | T | T | 115 | FY13 |
| Browns Falls Station 711 | R20 | WE | GM-4 | 01/01/1949 | NY08-0610 | T | T | 115 | FY13 |
| Browns Falls Station 711 | R30 | WE | GM-6B | 01/01/1960 | NY08-0610 | T | T | 115 | FY13 |
| Browns Falls Station 711 | R5 | GE | FK-439-2500 | 01/01/1969 | NY08-0610 | T | T | 115 | FY13 |
| Browns Falls Station 711 | R60 | GE | FK-439-2500 | 01/01/1969 | NY08-0610 | T | T | 115 | FY13 |
| Headson Station 146 | R100 | WE | GO-3A | 01/01/1956 | NY08-2520 | T | T | 115 | FY13 |
| Headson Station 146 | R70 | WE | GO-3A | 01/01/1956 | NY08-2520 | T | T | 115 | FY13 |
| Battle Hill Station 949 | R80 | WE | GM-3 | 01/01/1951 | NY08-0260 | T | T | 115 | FY14 |
| Battle Hill Station 949 | R40 | WE | GM-6 | 01/01/1952 | NY08-0260 | T | T | 115 | FY14 |
| Battle Hill Station 949 | R70 | WE | GM-6 | 01/01/1952 | NY08-0260 | T | T | 115 | FY14 |
| Teall Avenue Station 72 | R8105 | GE | FK-439-115-5000-5 | 01/01/1959 | NY08-6090 | T | T | 115 | FY14 |
| Teall Avenue Station 72 | R15 | GE | FK-439-115-5000-5 | 01/01/1959 | NY08-6090 | T | T | 115 | FY14 |
| Temple Station 243 | R805 | WE | GM-6B | 01/01/1960 | NY08-6100 | D | T | 115 | FY14 |
| Temple Station 243 | R815 | WE | GM-6B | 01/01/1960 | NY08-6100 | D | T | 115 | FY14 |
| Temple Station 243 | R825 | WE | GM-6B | 01/01/1960 | NY08-6100 | D | T | 115 | FY14 |
| Temple Station 243 | R835 | WE | GM-6B | 01/01/1960 | NY08-6100 | D | T | 115 | FY14 |
| Ash Street Station 223 | R8305 | A-C | BZO-115-5000-H | 03/01/1958 | NY08-0140 | D | T | 115 | FY15 |
| Ash Street Station 223 | R70 | GE | FK-115-5000 | 01/01/1959 | NY08-0140 | T | T | 115 | FY15 |
| Ash Street Station 223 | R80 | GE | FK-115-5000 | 01/01/1959 | NY08-0140 | T | T | 115 | FY15 |
| Ash Street Station 223 | R8105 | GE | FK-115-5000 | 01/01/1959 | NY08-0140 | T | T | 115 | FY15 |
| Ash Street Station 223 | R90 | WE | GM-6B | 01/01/1960 | NY08-0140 | T | T | 115 | FY15 |
| Geres Lock Switching Station 30 | R815 | WE | GM-6 | 01/01/1955 | NY08-2230 | T | T | 115 | FY15 |
| Marshville Station 299 | R11 | GE | FK-139-115-2500 | 06/01/1953 | NY09-1750 | T | T | 115 | FY15 |
| Peat Street Station 250 | R825 | WE | GM-6B | 01/01/1960 | NY08-4650 | D | T | 115 | FY15 |
| Ticonderoga Station 163 | R4 | GE | FK-115-5000 | | NY09-3100 | T | T | 115 | FY15 |
| [redacted] | R61 | GE | FGK-345-25000-4 | 01/01/1955 | NY09-2140 | T | T | 345 | FY16 |
| [redacted] | R81 | GE | FGK-345-25000-4 | 01/01/1955 | NY09-2140 | T | T | 345 | FY16 |
| [redacted] | R82 | GE | FGK-345-25000-4 | 01/01/1955 | NY09-2140 | T | T | 345 | FY16 |

| Station_Name | OP_Desc | Manuf | Mfr_Type | Mfr_Date | Station_No | FERC | Func | kV | Proposed Year |
|---|---|---|---|---|---|---|---|---|---|
| Queensbury Station 295 | R10 | WE | GM-6B | 01/01/1963 | NY09-2430 | T | T | 115 | FY16 |
| Queensbury Station 295 | R5 | WE | GM-6B | 01/01/1963 | NY09-2430 | T | T | 115 | FY16 |
| Queensbury Station 295 | R81 | WE | GM-6B | 01/01/1963 | NY09-2430 | T | T | 115 | FY16 |
| Tilden Station 73 | R150 | WE | GM-6 | 01/01/1952 | NY08-6140 | T | T | 115 | FY16 |
| Tilden Station 73 | R190 | WE | GM-6 | 01/01/1952 | NY08-6140 | T | T | 115 | FY16 |
| Tilden Station 73 | R160 | WE | GM-6B | 01/01/1960 | NY08-6140 | T | T | 115 | FY16 |
| Curtis Street Station 224 | R100 | GE | FK-439-115-1500-1 | 01/01/1968 | NY08-1360 | T | T | 115 | FY17 |
| Curtis Street Station 224 | R130 | GE | FK-439-115-1500-1 | 01/01/1968 | NY08-1360 | T | T | 115 | FY17 |
| Schuyler Station 663 | R130 | GE | FK-115-5000 | 01/01/1962 | NY08-5470 | T | T | 115 | FY17 |
| Schuyler Station 663 | R70 | GE | FK-115-5000 | 01/01/1962 | NY08-5470 | T | T | 115 | FY17 |
| Whitehall Station 187 | R13 | WE | GM-6B | 01/01/1958 | NY09-3320 | T | T | 115 | FY17 |
| Whitehall Station 187 | R3 | WE | GM-6B | 01/01/1958 | NY09-3320 | T | T | 115 | FY17 |
| Whitehall Station 187 | R6 | WE | GM-6B | 01/01/1958 | NY09-3320 | T | T | 115 | FY17 |
| Yahnundasis Station 646 | R60 | GE | FK-439-115-3500-3 | 01/01/1959 | NY08-6770 | T | T | 115 | FY17 |
| Yahnundasis Station 646 | R10 | GE | FK-439-115-3500-3 | 01/01/1959 | NY08-6770 | T | T | 115 | FY17 |
| Yahnundasis Station 646 | R30 | GE | FK-439-115-3500-3 | 01/01/1959 | NY08-6770 | T | T | 115 | FY17 |
| Oswego Switch Yard | R15 | GE | FK-439-115-5000 | 01/01/1956 | NY08-4470 | T | T | 115 | FY18 |
| Oswego Switch Yard | R20 | GE | FK-115-5000 | 01/01/1962 | NY08-4470 | T | T | 115 | FY18 |
| Oswego Switch Yard | R30 | GE | FK-115-5000 | 01/01/1962 | NY08-4470 | T | T | 115 | FY18 |
| Oswego Switch Yard | R50 | GE | FK-115-5000 | 01/01/1962 | NY08-4470 | T | T | 115 | FY18 |
| Oswego Switch Yard | R85 | GE | FK-115-5000 | 01/01/1993 | NY08-4470 | T | T | 115 | FY18 |
| [redacted] | R2123 | S-AC | BZO-121-63-6 | 09/01/1990 | NY07-2460 | T | T | 115 | FY18 |
| [redacted] | R2173 | S-AC | BZO-121-63-6 | 09/01/1990 | NY07-2460 | T | T | 115 | FY18 |
| [redacted] | R2193 | S-AC | BZO-121-63-6 | 07/01/1991 | NY07-2460 | T | T | 115 | FY18 |
| [redacted] | R833 | GE | FGK-230-15000-1 | 01/01/1959 | NY07-1140 | T | T | 230 | FY19 |
| [redacted] | R853 | GE | FGK-230-15000-1 | 01/01/1959 | NY07-1140 | T | T | 230 | FY19 |
| [redacted] | R823 | GE | FGK-230-15000-1 | 01/01/1960 | NY07-1140 | T | T | 230 | FY19 |
| [redacted] | R843 | GE | FGK-230-15000-1 | 01/01/1965 | NY07-1140 | T | T | 230 | FY19 |
| [redacted] | R735 | GE | FGK-230-15000-1 | 01/01/1965 | NY07-1140 | T | T | 230 | FY19 |
| [redacted] | R745 | WE | 2300GW15000 | 01/01/1967 | NY07-1140 | D | T | 230 | FY19 |
| [redacted] | R755 | WE | 2300GW15000 | 01/01/1967 | NY07-1140 | D | T | 230 | FY19 |
| [redacted] | R863 | WE | 2300GW15000 | 01/01/1967 | NY07-1140 | D | T | 230 | FY19 |
| [redacted] | R873 | WE | 2300GW15000 | 01/01/1967 | NY07-1140 | D | T | 230 | FY19 |

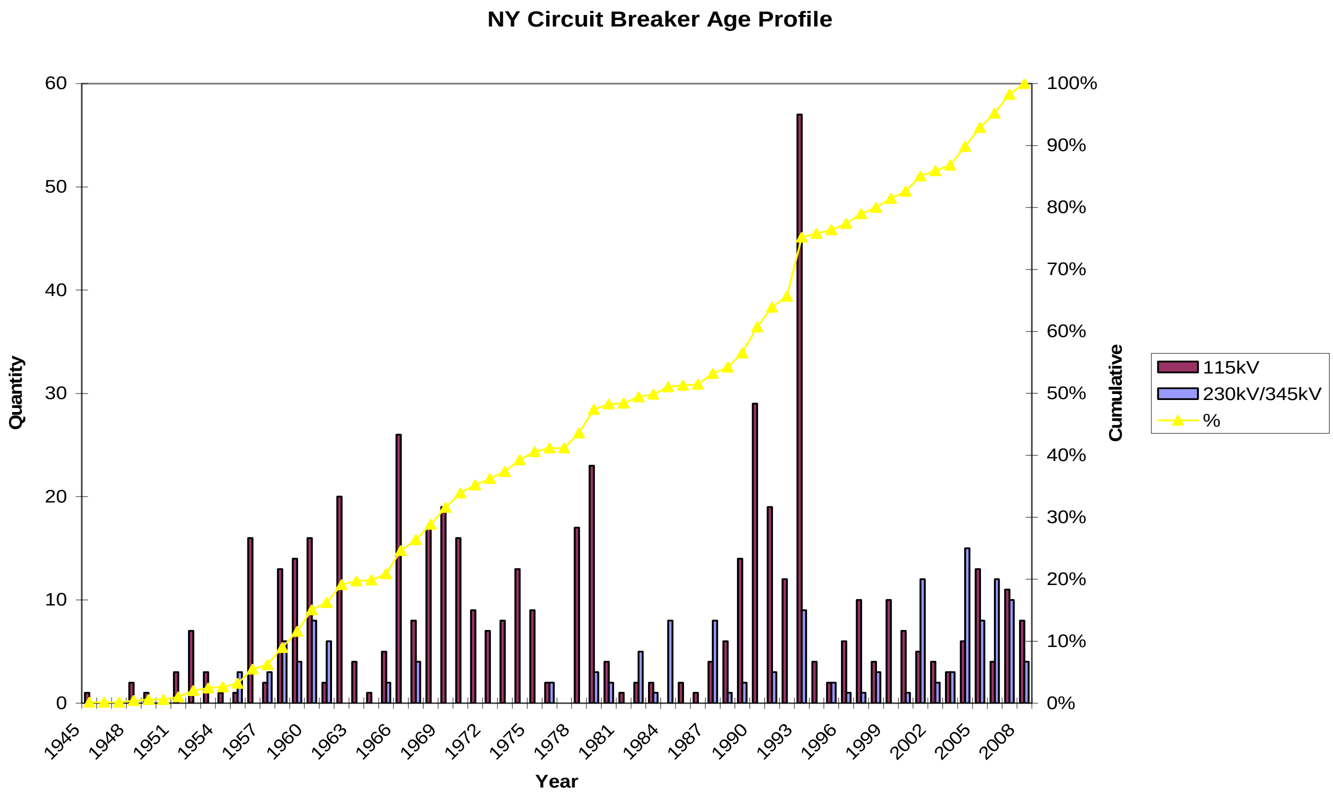
| Station_Name | OP_Desc | Manuf | Mfr_Type | Mfr_Date | Station_No | FERC | Func | kV | Proposed Year |
|---|---|---|---|---|---|---|---|---|---|
| Homer Hill Switch Structure | R33 | A-C | BZO-115-5000H | 02/01/1955 | NY07-1330 | T | T | 115 | FY20 |
| Homer Hill Switch Structure | R13 | GE | FK-439-115-5000-3 | 01/01/1956 | NY07-1330 | T | T | 115 | FY20 |
| Homer Hill Switch Structure | R59 | WE | GM-6 | 01/01/1952 | NY07-1330 | T | T | 115 | FY20 |
| Homer Hill Switch Structure | R65 | WE | GM-6 | 01/01/1952 | NY07-1330 | T | T | 115 | FY20 |
| Homer Hill Switch Structure | R51 | S-AC | BZO-121-63-6 | 08/01/1988 | NY07-1330 | T | T | 115 | FY20 |
| Homer Hill Switch Structure | R75 | S-AC | BZO-121-40-6 | 05/01/1993 | NY07-1330 | T | T | 115 | FY20 |
| Station 064 | R300 | GE | FK-115-5000 | 01/01/1959 | NY07-3640 | D | T | 115 | FY20 |
| Station 212 | R88 | WE | 1150GM5000 | 01/01/1965 | NY07-4220 | D | T | 115 | FY20 |
| Batavia Station 01 | R64 | GE | FK-439-115-5000-3 | 01/01/1956 | NY07-0240 | T | T | 115 | FY21 |
| Batavia Station 01 | R90 | A-C | BZO-115-5000-H | 06/01/1960 | NY07-0240 | T | T | 115 | FY21 |
| Batavia Station 01 | R40 | A-C | BZO-115-5000-H | 06/01/1960 | NY07-0240 | T | T | 115 | FY21 |
| Batavia Station 01 | R80 | GE | FK-439-2500 | 01/01/1969 | NY07-0240 | T | T | 115 | FY21 |
| Cortland Station 502 | R180 | GE | FK-115-5000 | 01/01/1959 | NY08-1290 | D | T | 115 | FY21 |
| Cortland Station 502 | R20 | GE | FK-439-115-5000-3 | 01/01/1956 | NY08-1290 | D | T | 115 | FY21 |
| Cortland Station 502 | R30 | WE | GO-3A | 01/01/1956 | NY08-1290 | D | T | 115 | FY21 |
| Cortland Station 502 | R8105 | GE | FK-115-5000 | 01/01/1962 | NY08-1290 | D | T | 115 | FY21 |
| Woodard Station 233 | R40 | GE | FK-115-5000 | 01/01/1962 | NY08-6750 | T | T | 115 | FY22 |
| Woodard Station 233 | R8105 | GE | FK-115-5000 | 01/01/1962 | NY08-6750 | T | T | 115 | FY22 |
| Woodard Station 233 | R170 | GE | FK-115-5000 | 01/01/1962 | NY08-6750 | T | T | 115 | FY22 |
| Golah Station | R249 | GE | FK-115-5000 | 01/01/1959 | NY07-1240 | T | T | 115 | FY22 |
| Golah Station | R69 | GE | FK-439-115-5000-3 | 01/01/1956 | NY07-1240 | T | T | 115 | FY22 |
| Golah Station | R246 | GE | FK-439-115-5000-3 | 01/01/1956 | NY07-1240 | T | T | 115 | FY22 |
| Terminal Station 651 | R60 | GE | FK-115-5000 | 01/01/1962 | NY08-6110 | T | T | 115 | FY22 |
| Terminal Station 651 | R70 | GE | FK-115-5000 | 01/01/1962 | NY08-6110 | T | T | 115 | FY22 |
| Terminal Station 651 | R8105 | GE | FA-115-5000 | | NY08-6110 | T | T | 115 | FY22 |

**Appendix 2**




Note: In 2006 National Grid introduced a new method of trouble reporting

## Appendix 3


NY Circuit Breaker Age Profile
Quantity
Cumulative
Year
0
10
20
30
40
50
60
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
1945
1948
1951
1954
1957
1960
1963
1966
1969
1972
1975
1978
1981
1984
1987
1990
1993
1996
1999
2002
2005
2008
115kV
230kV/345kV
%