

January 27, 2011

Nancy McNeil
Regulatory Affairs Officer/Clerk
Nova Scotia Utility and Review Board
1601 Lower Water Street, 3rd Floor
P.O. Box 1692, Unit "M"
Halifax, NS B3J 3S3

**Re: CI 40425 – Kempt Road Transformer - NSPI Information Requests (IRs) -
P -510/Matter No. 03715**

Dear Ms. McNeil:

Enclosed are the IR responses pertaining to the capital item referenced above.

These IRs were received on December 24, 2010.

The attachment in response to IR-3(a) is confidential due to security concerns. Protection of the power system preserves reliability and reduces the risks associated with external threats. This diagram is filed with the Board in hard copy only.

Regards,


Lee Thomson-Lutz MBA, CMA
Manager, Capital

Encl.

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Request IR-1:

On page 4 of 20, under "Why do this project now?", NSPI states this project is being advanced at this time to reduce the probability of loss of load due to a transformer failure. Please provide specific information to support the above statement and to justify the decision to submit this project as a U&U work order, and not as a part of the 2011 ACE Plan.

Response IR-1:

The Kempt Road substation normally has 3 x 138-25 kV transformers in-service. In 2010, two transformers failed and were at the factory being rewound leaving only one transformer in-service along with a mobile transformer. The remaining in-service transformer was installed in 1976 and has never failed. If this transformer had failed, NSPI would not have been able to supply the entire load normally supplied from the Kempt Road substation.

After the second transformer failed in September, NSPI brought this project forward as a U&U rather than including this item as part of the 2011 ACE Plan.

Once NSPI receives this new transformer, this unit will remain as an energized spare for the Kempt Road substation.

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Request IR-2:

The work order application, submitted to the Board on November 24, 2010, identifies an estimated start date of 2010-10 and an estimated in-service date of 2011-08. Please provide the work schedule for 2010 and 2011.

Response IR-2:

Below is the work schedule for the Kempt Road transformer:

January 2011	NSPI plans to order this spare transformer by Jan.31/2011.
August/September 2011	The spare transformer arrives from the factory.
September/October 2011	The spare transformer will be installed at the substation.

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Request IR-3:

On page 2 of 20 of the submission it is stated that the new unit would be connected as an energized spare at Kempt Road and would be utilized in the event of a failure "of the existing three transformers". On page 4 of 20 it is stated that there is a very high probability of extended loss of load if "the remaining unit fails":

(a) Please provide a copy of the Kempt Road substation single line diagram under normal configuration;

(b) Please compare the current configuration with the normal configuration.

Response IR-3:

(a) Please refer to Confidential Attachment 1.

(b) The current configuration is identical to the normal situation. There are 3 x 138-25 kV transformers supplying area load. The single transformer that did not fail remains in service. One of the units that failed in 2010 has been rewound and is now back in service. A transformer was taken from another location and placed in-service at Kempt Road.

The fourth transformer will be installed at the substation as an energized spare and as such the configuration of the substation will change once it is installed.

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Request IR-4:

Please elaborate on the estimated load and the maximum contingency capacity of the Kempt Road substation for the 2010/11 and 2011/12 winter peaks.

Response IR-4:

The load and contingency capacity of the Kempt Road substation along with the two other substations on the Halifax Peninsula is indicated below. There is a minimal difference between the 2010/11 and 2011/12 winter peak load that will not affect the maximum contingency capacity of the Kempt Road Substation. It is for this reason that the information provided below is not broken out as requested.

The maximum peak load of the substation transformers on the peninsula of Halifax at 104H Kempt Rd, 1H Water St and 2H Armdale is as follows:

Kempt Road Substation

104H-T61 = 38 MVA

104H-T62 = 35 MVA

104H-T63 = 44 MVA

Water Street Substation

1H-T61 = 41 MVA

1H-T62 = 29 MVA

Armdale Substation

2H-T61 = 28 MVA

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Response IR-4: (cont'd)

If NSPI were to lose the most heavily loaded of the 3 transformers at 104H Kempt Road, NSPI could do the following transfers of load:

- transfer 20 MVA on a short-term basis onto the mobile transformer
- transfer 7 MVA from T62 onto T61
- pick-up the remaining 14 MVA on T62
- 10 MVA of load would be transferred from T63 to the Water Street transformers.

Based on these considerations, the revised load would be served as follows:

Kempt Road Substation

104H-T61 = 45 MVA

104H-T62 = 42 MVA

104H-T63 = 0 MVA

Mobile = 20 MVA

Water Street Substation

1H-T61 = 46 MVA

1H-T62 = 34 MVA

If NSPI were to lose the two most heavily loaded transformers at 104H Kempt Road, NSPI could do the following:

- transfer 22 MVA from T61 on a short-term basis onto the mobile transformer
- transfer another 10 MVA from T61 onto 1H Water St,
- transfer 6 MVA from T61 onto T62.
- transfer 8 MVA from T63 onto 2H Armdale,

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Response IR-4: (cont'd)

- transfer 23 MVA from T63 onto 1H Water St,
- transfer 13 MVA from T63 onto T62:

Based on these considerations, the revised load would be served as follows:

Kempt Road

104H-T61 = 0 MVA

104H-T62 = 54 MVA

104H-T63 = 0 MVA

Mobile Transformer= 22 MVA

Armdale Substation

2H-T61 = 36 MVA

Water Street Substation

1H-T61 = 51 MVA

1H-T62 = 52 MVA

If NSPI were to lose all 3 transformers at 104H Kempt Road, NSPI could follow the same plan referenced above for the two transformers. NSPI would then have to offload an additional 54 MVA from T62 at Kempt Road onto both 2H Armdale and 1H Water Street substations. Due to the limitation of the feeder connections and the substation transformers themselves, there would not be enough capacity for this remaining load.

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Request IR-5:

In its approval request (page 4 of 20) NSPI states that since 2001 there have been four transformer failures at Kempt Road:

- (a) Please describe the findings of the investigations into the root cause of these failures;**
- (b) Which corrective measures and/or procedures have been developed by NSPI to decrease the probability of future transformer failures at this substation?**

Response IR-5:

- (a) The investigations revealed that the root cause of the failures was transformer through faults. Through faults are caused by an interruption on the distribution system, such as trees coming in contact with a line. This causes a fault which stresses the transformer at the substation. These faults are generally close to the substation. Since the Kempt Road substation is located at a high “fault level” point on the system, the transformer “sees” these faults before they are cleared by appropriate protection.
- (b) Prior to the onset of a significant wind event, the reclosers at the Kempt Road substation are set to single shot reclosing. This means that following a fault the reclosers will not re-energize the distribution circuit.

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1 **Request IR-6:**

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3 **On page 4 of 20, under "Why do this project", NSPI states:**

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5 **It is expected that one of the three transformers that has not been removed**
6 **from service to be rewound is at risk of failure due to the high number of**
7 **faults in the area.**
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9 **Please elaborate and provide documentation that support the above statement (such as a**
10 **study, report, etc.).**
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12 **Response IR-6:**
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14 There is no documentation to support this statement. This statement was based on the fact that
15 NSPI has experienced a high number of transformer through faults on the distribution circuits out
16 of Kempt Road substation. The remaining transformer was installed in 1976. Based on the
17 failure history of the other two transformers at this substation, NSPI believes this unit is at a high
18 risk to fail.

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Request IR-7:

With respect to the transformers currently being used at the Kempt Road substation, as well as the two transformers that are being rewound, please provide their age and the remaining life expectancy. Please elaborate.

Response IR-7:

The age of the transformers at the Kempt Road substation are listed below:

104H-Txx	new in 2011
104H-T61	1989 (This unit was rewound in 2010. This unit will be back in-service in Sept./Oct. 2011.)
104H-T62	1976
104H-T63	1976 (This unit was rewound in 2001,/2010. This unit was put back in service in Nov. 2010.)

The life expectancy of power transformers on the NSPI system is approximately 45 years. NSPI believes the life expectancy of the units at Kempt Road is less than 45 years due to the through fault activity experienced at this substation.

As referenced in response to IR-1, this new transformer will remain as an energized spare for the Kempt Road substation.

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Request IR-8:

Based on historical NSPI data, what is a typical life expectancy of transformers being used at the Kempt Road substation?

Response IR-8:

The typical life expectancy for power transformers on the NSPI system is approximately 45 years. Due to through fault activity at Kempt Road substation the life expectancy is less than 45 years.

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Request IR-9:

It is stated that, as the result of recent transformer failures (one on July 5, 2009 and the second on September 4, 2010), two transformers were removed from service and shipped to the factory to be rewound. Please identify the factory and its location, and provide the expected dates for return of these units to the Kempt Road substation location.

Response IR-9:

Transformer 104H-T63 was shipped to Jordan Transformer in Jordan, Minnesota. This unit was returned to service in November 2010.

Transformer 104H-T61 was shipped to Southwest Electric in Oklahoma City. This unit is expected to be delivered to the Kempt Road substation in September, or October 2011.

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Request IR-10:

Please provide a listing of all 138kV system spare transformers that could be utilized at the Kempt Road substation, including multi-voltage and mobile transformers. Identify where these transformers are normally located and which spares are currently in service.

Response IR-10:

There is a single large spare power transformer (28/37/47 MVA) located in Onslow at NSPI's storage facility. The winding configuration is such that it cannot be paralleled with the existing units without taking an outage. The spare transformer located at the Onslow storage yard is currently not in-service.

There is at 25 MVA mobile transformer located in Lakeside and another 25MVA mobile transformer located in Sydney. Both of these mobile transformers can be used at Kempt Road. Mobile transformers are in and out of service on a regular basis and are readily available for emergency situations.

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Request IR-11:

Please describe the use of common spare transformers shared by multiple NSPI's substations.

Response IR-11:

For power transformer failure response on NSPI's transmission system, a combination of substation mobile transformers and designated out of service (not currently energized) and in service system spare transformers are employed to return service to the areas affected. Due to the flexibility of movement and the compactness of a mobile transformer, installation is usually restricted to a 15-30 day period to allow availability for future emergency use. The mobile is then replaced by an out of service, or available in-service unit until the faulted transformer has been repaired and returned to site.

As noted in IR-10 there is a spare unit available for Kempt Road, but the winding configuration necessitates that an outage would be required to install this transformer at Kempt Road. This project will serve to permanently install this new transformer at Kempt Road as an energized spare at this substation.

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Request IR-12:

Please describe the method used by NSPI to determine the optimal number of substation spare transformers.

Response IR-12:

Several years ago NSPI reviewed the optimal number of out of service substation and in service power transformers that should be available in the event of a serious in-service transformer failure requiring extended repair at an approved facility. At this time, there were 6 out of service system spare transformers in inventory and 11 in-service power transformers that could be temporarily available as spares. This number has since been reduced to 3 out of service spares and 8 in-service spares. NSPI has adopted guidelines used by Hydro One. The results of these new guidelines are listed below:

- 1 spare required for 1 to 24 units in-service
- 2 spares required for 25 to 65 units in-service
- 3 spares required for 66 to 135 units in-service

At this time, NSPI looked at the 189 various power transformers on the system.

The result of this review was for NSPI to purchase one 138x69/13.2 kV, 15/20/25 MVA transformer and replace a transformer at an existing substation with a unit that would become available due to modifications at another station.

As noted in IR-10 there is a restriction on the spare that could be used at Kempt Road substation. Therefore, NSPI's recommends that an energized spare be installed at the Kempt Road substation.

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1 **Request IR-13:**

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3 **Please provide a cost breakdown and elaborate on the amount of \$46,000 for Other Goods**
4 **& Services.**

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6 Response IR-13:

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8 There is no cost breakdown for the \$46,000. This is a lump sum contract for an external
9 company to witness tests on the transformer. This price includes travel and other expenses
10 associated with this testing.

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Request IR-14:

Please discuss the other alternatives and provide a justification that an immediate purchase of a new transformer is the lowest cost option.

Response IR-14:

As provided in the response to IR-4, there are limitations associated with transferring the entire Kempt Road load to alternate sources within the Halifax Peninsula.

NSPI could construct additional 25 kV feeders from Kempt Road substation to alternate stations. The streets of the Halifax Peninsula are currently congested with overhead plant associated with power, telecommunication, and cable facilities.

The following two options were examined prior to developing this capital work application:

Option 1

To avoid the congestion referenced above, one option would be to build approximately 5 underground feeders from Kempt Road substation to other substations such as Water St. and/or Armdale. This would include the construction of underground duct banks and the installation of new feeders in these duct banks.

In the 2010 ACE Plan the cost to replace two 25 kV feeders, 2.8 km in length, in existing duct banks in the pole free area of downtown Halifax was estimated to be approximately \$592,567. The cost to construct additional duct banks, a few kms in length, and the associated feeders out of Kempt Road substation would far exceed the alternative of purchasing an energized spare transformer for Kempt Road substation. Additional costs greater than

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Response IR-14: (cont'd)

\$1,000,000 would be also be required to terminate these circuits at Kempt Road and terminate either one, or both of the other two substations on the Halifax Peninsula.

Option 2

NSPI could build new feeders on the streets of the Halifax Peninsula. As noted above the streets are congested with overhead plant. As such, single circuit feeders would require removal to be replaced with double circuit feeders. This exercise would require service to customers along these streets be maintained during construction. A rough estimate for this type of work would be in the order of approximately \$150,000/km. This would require approximately 5 circuits with each being over 1 km. In addition there would be costs greater than \$1,000,000 to terminate these circuits at Kempt Road and terminate either one or both of the other two substations on the Halifax Peninsula. This cost would exceed the cost of purchasing an energized spare for Kempt Road substation.

Due to the high cost of the two distribution feeder options, there was no further examination of additional transformation capacity on the Halifax Peninsula to serve contingency situations at the Kempt Road substation. It is for this reason, the recommended alternative is being advanced. Additional transformation capacity would cost at least \$1,000,000 per unit at either one or both of the other two substations on the Halifax Peninsula.