

REFERENCE:

Appendix 7.7, page 16 to 19

PREAMBLE TO IR (IF ANY):

At page 1 MH states:

As noted in previous correspondence to the PUB, Manitoba Hydro did not prepare a capital expenditure forecast (“CEF”), as previously known, due to the ongoing work on Strategy 2040 initiatives, including the development of an Integrated Resource Plan and anticipated completion of Provincial Energy Policy.

QUESTION:

- a) Please file the correspondence with the PUB referenced in the pre-amble, including any response from the PUB.

RESPONSE:

Please see Attachment 1 to this response for a copy of Manitoba Hydro’s letter to the PUB on October 15, 2021.

Please see Attachment 2 to this response for a copy of the PUB’s response to Manitoba Hydro on October 19, 2021.



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October 15, 2021

THE PUBLIC UTILITIES BOARD OF MANITOBA
400-330 Portage Avenue
Winnipeg, Manitoba
R3C 0C4

ATTENTION: Dr. D. Christle, Board Secretary and Executive Director

Dear Dr. Christle:

RE: Manitoba Hydro Comments on Intervener Minimum Filing Requirements for the Interim Rate Application

On October 12, 2021, the Public Utilities Board of Manitoba (“PUB”) issued a letter with respect to Manitoba Hydro’s request for the PUB to discontinue the Status Update Process and replace it with an expediated process to review an interim rate application. In its letter, the PUB requested Interveners to provide proposed Minimum Filing Requirements (“MFRs”) for an interim rate application process by October 13th and requested Manitoba Hydro provide comments on Intervener proposed MFRs by October 15th.

On October 13, 2021 the Consumers Coalition (the “Coalition”), the Manitoba Industrial Power Users Group (“MIPUG”) and the Assembly of Manitoba Chiefs (“AMC”) provided updated MFRs for an expected interim rate application. In reviewing the appropriateness of the Intervener proposed MFRs for this interim application process, Manitoba Hydro has considered the PUB’s previous guidance that interim rates are to be set without a full evidentiary record, are adjudicated on a less onerous legal standard than final rates, and should not consider contentious issues¹. More recently for this specific process, the PUB directed in its October 12, 2021 letter that MFRs should be “specifically relevant to an expected interim rate increase application by Manitoba Hydro and are not duplicitous of the PUB MFRs.”

As indicated in its September 29th letter to the PUB, Manitoba Hydro will be requesting expedited review of an interim rate increase for 2021/22 and may also request the PUB consider a conditional interim rate increase for 2022/23. To reiterate, Manitoba Hydro intends to provide responses to the greatest extent possible, to each of the 21 MFRs requested by the PUB, which cover a wide range of topics. Many of the Intervener MFRs request information that MH intends to include as part of its application and other Intervener MFRs request similar information as the PUB MFRs. As such, the requirement for Manitoba Hydro to respond to additional intervener MFRs are not necessary or required to assist the PUB in making a determination of rates. Manitoba Hydro’s interim rate application will be comprehensive and will enable the PUB to determine the

¹ See PUB Order 80/17 at page 21-22; PUB Order 59/18 at page 18-19.

application in an expeditious manner with minimal, or no, additional evidence or information requests required.

After the application is filed with the PUB, Manitoba Hydro of course expects that the PUB will provide Interveners with a fair opportunity to comment upon the application and advance a position as to whether or not Manitoba Hydro has established a prima facie case for interim rate relief given the deleterious financial impact caused by the drought.

In its October 13th letter to the PUB, Manitoba Hydro communicated that the earliest it expects to be in a position to file its rate application to meet the onus it bears is November 15th. This indicative timing is an aggressive target and assumes that Manitoba Hydro efforts will be fully consumed in developing its application and the responses to the MFRs proposed by the PUB. If responses to Interveners MFRs are also required, this will impact the filing date for the application and potentially delay the approval of urgent rate relief required because of the drought.

Should the PUB determine that responses to certain Interveners MFRs are required, Manitoba Hydro provides the following comments on specific Intervener MFRs.

Comments on Intervener Minimum Filing Requirements where information is not available:

- The Coalition has requested variance analysis for each line item on the income statement for 2020/21 to 2022/23, similar to the detailed analysis provided in Tab 6 of Manitoba Hydro's 2017 General Rate Application ("GRA"). Manitoba Hydro will not be able to provide detailed variance analysis typically provided in a GRA, as this is an extensive work effort and this level of detail is not warranted for this Application. As part of its Application, Manitoba Hydro expects to provide an overview of the drivers of significant change in its current 2021/22 Forecast relative to the 2021/22 Budget, as well as an overview of the significant drivers of change in the 2022/23 Budget relative to its 2021/22 Forecast.
- The Coalition has requested a differential comparison of Manitoba Hydro's forecast and budget financial statements for 2020/21 to 2022/23 with Exhibit 93 from the 2017 GRA. A line item comparison of Manitoba Hydro's current forecast and budget with a scenario produced in the 2017 GRA based on its 2016 financial forecast is an extensive work effort and a detailed comparison is not relevant or practical, in particular in the context of an interim rate application.
- The Coalition has requested quarterly budgets for 2021/22 and 2022/23 based on different water flow scenarios and MIPUG MFR #15 requests information on different financial scenarios reflecting forecast water flow assumptions and high/reference/low export prices, with reference to several Information Request responses from the 2017 GRA with information extending to 2026/27. As part of its Application, Manitoba Hydro expects to provide different scenarios for 2021/22 and 2022/23 based on a range of water flow conditions and energy purchase price scenarios. This information will not be available quarterly but rather on an annual basis for 2021/22 and 2022/23 only.
- MIPUG MFR #2 requests information on current staffing levels and forecast full-time equivalent employees ("FTEs") by department, including details on staffing levels arising from external directives to reduce costs. With its Application, Manitoba Hydro intends to provide details of saving achieved through the government savings initiative related to the COVID-19 pandemic and information on current and budgeted O&A levels and FTEs on an overall basis. However, due to the ongoing Business Model Review, Manitoba Hydro is unable to provide

positions or FTE information by division or department at this time.

- MIPUG MFR #3 requests updates to the quantitative and detailed uncertainty analysis provided in the 2017 GRA. Manitoba Hydro has not updated the probabilistic risk analysis associated with the financial target review presented at the 2017 GRA. Manitoba Hydro supported the financial targets set out in Bill 35, and can provide information on Manitoba Hydro's financial ratios relative to other Canadian utilities for consideration by the PUB.
- MIPUG has requested a long-term (20-year) Electric Load Forecast (MIPUG MFR #5), Capital Expenditure Forecast (MIPUG MFR #6), and Debt Management Strategy (MIPUG MFR #8). As previously noted by Manitoba Hydro, due to the ongoing work on Strategy 2040 initiatives, including the development of an Integrated Resource Plan reflecting Provincial Energy Policy, Manitoba Hydro does not presently have these long-term forecasts available.
 - In response to PUB MFR #16, Manitoba Hydro will provide details of its current electric load forecast information up to and including 2022/23, as well as discussion related to the impacts of COVID-19.
 - In response to PUB MFR #19, Manitoba Hydro will provide details of its capital expenditure forecast for the next 5 years, consistent with timeframe provided to the Treasury Board for approval.
- MIPUG MFR #13 requests risk scenarios for drought in comparison to other risks, with reference to a previous Information Request response with information extending out to 2027/28. Manitoba Hydro's application will focus on the most significant risk faced by the Corporation which is related to drought and will provide information on other significant risks for 2021/22 and 2022/23 only.
- AMC has requested any further residential energy use surveys completed since the 2017 Residential Energy Use Survey. Manitoba Hydro has not completed any further residential energy use surveys since 2017.

Minimum Filing Requirements that are duplicative of the PUB's MFRs:

- Coalition has requested credit rating reports for the Province of Manitoba. Manitoba Hydro notes these will be provided in response to PUB MFR #14.
- MIPUG's request for financial statements for Manitoba Hydro's electric operations (MIPUG MFR #4) will be provided in response to PUB MFR #3.
- MIPUG MFR #9 requests the interest rate forecast, which will be provided in response to PUB MFR #13.
- In PUB MFR #8, the PUB has requested the financial impact of a prolonged drought. MIPUG has provided three separate MFRs requesting similar analysis (MIPUG MFR #7, #12 and #14). Manitoba Hydro will provide a response to the PUB MFR and does not believe these additional MFRs by MIPUG are required in the context of an interim rate application.

As indicated in its letter of September 29th, Manitoba Hydro has continued to assess and review the financial impacts of the drought. The Corporation anticipates sharing additional information about these impacts publicly in the near term, in advance of the filing of its interim rate application. Manitoba Hydro is confident that when this information will be released publicly, it will demonstrate to all of its customers and stakeholders the immediate need for interim rate relief from the PUB.

Public Utilities Board of Manitoba
Comments on Intervener Minimum Filing Requirements

October 15, 2021
Page 4 of 4

Should you have any questions with respect to this submission, please contact the writer at 204-360-3257.

Yours truly,

MANITOBA HYDRO LEGAL SERVICES

Per:



Brent Czarnecki
Barrister & Solicitor



October 19, 2021

Via Email

Mr. Brent Czarnecki
Legal Counsel
Manitoba Hydro

Mr. Byron Williams and Mr. Chris Klassen
Public Interest Law Centre

Mr. Antoine Hacault
Legal Counsel for the Manitoba Industrial Power Users Group
Thompson Dorfman Sweatman LLP

Ms. Carly Fox
Legal Counsel for the Assembly of Manitoba Chiefs
Fox Fraser LLP

Mr. Brennan Manoakesick
Manitoba Keewatinowi Okimakanak

Mr. Markus Buchart
Legal Counsel for Manitoba Keewatinowi Okimakanak
Jerch Law

Dear Parties:

Re: Manitoba Hydro's Status Update Proceeding and Manitoba Hydro's Interim Rate Application

Background:

In the Public Utilities Board's ["Board's"] October 12, 2021 Decision Letter and based on the stated urgency by Manitoba Hydro for an interim rate increase application for fiscal year 2021/22, the Board suspended the current Status Update Proceeding with the requirement that Manitoba Hydro's interim rate application be filed by November 3, 2021.

Manitoba Hydro's Request for an Extension of Time:

400 – 330 Portage Avenue
Winnipeg, MB R3C 0C4
T 204-945-2638 / 1-866-854-3698
F 204-945-2643
Email: publicutilities@gov.mb.ca
Website: www.pubmanitoba.ca

330, avenue Portage, pièce 400
Winnipeg (Manitoba) Canada R3C 0C4
Tél. 945-2638 / 1-866-854-3698
Télé. 945-2643
Courriel : publicutilities@gov.mb.ca
Site Web: www.pubmanitoba.ca

Manitoba Hydro requests the Board extend the filing deadline to November 15, 2021 as they advise this is the earliest date by which they will be able to obtain approval from the Manitoba Hydro Board of Directors to file its interim rate application in satisfaction of the September 22, 2021 Directive issued by the Minister of Crown Services.

With the expectation that Manitoba Hydro's 2021/22 interim rate increase application will be comprehensive, including being based on the most up-to-date water conditions and information sought in the Board's September 9, 2021 Minimum Filing Requirements and the information in response to the attached list of approved Interveners' Minimum Filing Requirements, the Board approves and extends the filing deadline for the interim application until November 15, 2021.

Process Matters:

Manitoba Hydro's September 29, 2021 letter references that in light of the significant and deleterious financial impacts of the drought and the ministerial directive Manitoba Hydro will be requesting expedited Board approval of an interim rate increase for 2021/22. The Board is concerned that as a result in the delay in filing the interim rate application, the Board may not be able to adjudicate the matter within the timeframe initially intended.

The Board cannot finalize the process for the adjudication of Manitoba Hydro's interim rate application until it is received and reviewed. Additionally, other than an indication in the Board's October 12, 2021 Decision Letter that the Status Update Proceeding will be suspended on the filing of an interim rate application, the Board has not made further process decisions related to the Status Update Proceeding.

With Manitoba Hydro's filing date for its interim rate application now being delayed until November 15, 2021, the Board requests all Interveners and Manitoba Hydro provide the Board with written submissions, on or before October 22, 2021, as to the various process and procedural options and timelines available for each of the interim rate application and the Status Update Proceeding. Parties should also indicate their recommended process and procedures together with their reasons for their preferences.

Interveners' Suggested Minimum Filing Requirements ["MFRs"]:

As indicated in the Board's October 12, 2021 Decision Letter, the longstanding use of MFRs is to assist in the efficient and focused filing of complete rate increase applications by Manitoba Hydro and reduce subsequent written information requests.

In the Board's October 12, 2021 Decision Letter Interveners were requested to submit, by October 13, 2021, their suggested MFRs that are specifically relevant to an expected interim rate increase application by Manitoba Hydro. Manitoba Hydro was to provide its comments on Intervener MFRs to the Board by the end of the day on October 15, 2021. Interveners and Manitoba Hydro were also encouraged to discuss the MFRs to focus and reach consensus on relevant and available information. Thereafter the PUB indicated it would adjudicate which MFRs are to be included in Manitoba Hydro's interim rate application.

On October 15, 2021 Manitoba Hydro provided its comments to the Board as to which Intervener MFRs would be responded to in the interim rate application as well as the reasons for objecting to other Intervener MFRs.

The Board has considered the Intervener MFRs and, the comments by Manitoba Hydro on the Intervener MFRs. The Board has found some Intervener MFRs are duplicative of the PUB MFRs; some were addressed in Manitoba Hydro's October 15, 2021 response letter; and some went beyond the reasonable scope of an interim proceeding and would be more appropriate for a General Rate Application. Attached to this Decision Letter is the list of approved PUB MFRs and Interveners' MFRs that Manitoba Hydro is to address in its interim rate application.

Conclusion:

Any questions of clarification are to be forwarded in writing to the Board's office for response.

Regards,



Rachel McMillin
A/ Associate Secretary

RM/kls

cc: B. Peters (Board Counsel)
Shannon Gregorashuk / Darryl Martin (Manitoba Hydro)

Manitoba Hydro 2021/22 Interim Rate Application – Minimum Filing Requirements

Note: References in brackets indicate similar requests previously made. These references indicate how the information may be presented.

Manitoba Public Utilities Board – Approved Minimum Filing Requirements

Corporate

1. Details of all material changes in the Corporation's operations since the last GRA hearing.
2. Current Corporate Risk Analysis Report.

Financial Results and Forecasts

3. Actual, budgeted, outlook, or forecast operating statements, balance sheets, and cash flow statements (both direct and indirect methods) for 2020/21, 2021/22, 2022/23, and all additional forward years for which these documents exist. [2019 GRA Appendix 1, 2]
4. Quarterly Financial Statements for the current fiscal year.
5. MHEB 70th Annual Report for year ended March 31, 2021.
6. Details of the determination of each of the financial ratios (debt-to-equity, interest coverage, and capital coverage) for each of the years 2019/20 to 2022/23 and any future years as available. [2019/20 GRA PUB/MH 1-8]
7. Detail of the Net Movement in Regulatory Deferral Accounts including Opening and Closing Balances, Additions, and Amortizations. [2019 GRA - PUB/MH 10 a-c]
8. A table that shows the incremental and cumulative impacts to retained earnings of a 5- and 7-year drought, beginning in 2021/22. [2017/18 GRA PUB/MH II-40]
9. Revenue requirements including cost components (Finance/Depreciation/Operating/Water Rentals/F&PP/Taxes) for the years 2019/20, to 2023/24 for each of the following:
 - Keeyask generating station
 - Manitoba-Minnesota Transmission Project
 - Great Northern Transmission Line
 - Bipole III and Riel station
 - Birtle Transmission Project
 - Business Operations Capital

[2019/20 GRA PUB/MH I-9]

10. Continuity schedules showing the deferrals and amortization (or proposed amortization) of the Bipole III Deferral Account and the Major Capital Deferral Account. [2019/20 GRA PUB/MH I-11]

11. Incremental revenues and unit revenues from Keeyask by year, broken down by firm and opportunity sales. [2017/18 GRA PUB MFR 82]
12. Details of the impacts of COVID-19 pandemic on O&A expenditures in 2020/21 and 2021/22 to date.

Finance Expense and Debt

13. Current Economic and Financial Indicators (including interest rates) Forecast. [2019/20 GRA Additional Information Attachment 5]
14. Most recent credit rating reports from DBRS, Moody's, and S&P.
15. Manitoba Hydro's most recent presentation(s) made to each credit rating agency.

Export and Domestic Revenues

16. Current approved Electric Load Forecast and tables that show updates to both the load forecast and the actual loads resulting from the COVID-19 pandemic.
17. Updates to graphs of Annual System Inflows, Energy in Storage, Daily Hydraulic Energy from Inflow, and Total Hydraulic Generation.
18. Graphs and tables of net export revenues and net income for 2021/22 and 2022/23 for each of the possible water flow conditions (P1 to P100). [2019/20 GRA PUB/MH I-29(c)]

Capital Expenditures

19. Capital Expenditure Forecast. If there have been updates since the approved CEF provide a table that shows the updates.

COSS and Rate Design

20. PCOSS21 and allocation tables; and PCOSS22 (if available).
21. Proofs of Revenue for 2021/22 and 2022/23.

Consumers Coalition – Approved Minimum Filing Requirements

22. Please provide a detailed explanation of how Manitoba Hydro plans to revise its strategic actions for 2021/22 and 2022/23 to reduce the deleterious impacts of drought including:
 - a. Potential deferrals or reprioritizations of capital expenditures in the event of financial distress due to drought;
 - b. Potential O&A Expenses and other cost reductions that could be implemented in the event of financial distress; and
 - c. Potential adjustments to corporate strategies such as alternate debt management strategies and strategies to maximize domestic and net export revenues before asking for rate increases.

23. An explanation of the financial metrics Manitoba Hydro used to determine the level of proposed interim rate increase and how the assessment of these financial metric resulted in the rate relief sought in the interim rate application;
24. A detailed description of how Manitoba Hydro attempted to balance the financial integrity of the corporation with the impacts on customers, in making its interim rate request;
25. Further to PUB MFR #3, a breakdown of domestic revenues between revenues at existing rates and additional revenues from approved and projected rate increases;
26. Manitoba Hydro's Annual Business Plan for 2021/22;
27. Details of the contracted wage settlements in place for 2020/21, 2021/22 and 2022/23 [reference: Coalition/MH I-14 (j) from the 2019/20 Rate Application].

MIPUG – Approved Minimum Filing Requirements

28. Major Capital Projects Quarterly Reports to the PUB since the 2019/20 Rate Application.
29. Operating & Administrative Quarterly Reports to the PUB since the 2019/20 Rate Application.

REFERENCE:

Appendix 7.7, page 16 to 19

PREAMBLE TO IR (IF ANY):

At page 1 MH states:

As noted in previous correspondence to the PUB, Manitoba Hydro did not prepare a capital expenditure forecast (“CEF”), as previously known, due to the ongoing work on Strategy 2040 initiatives, including the development of an Integrated Resource Plan and anticipated completion of Provincial Energy Policy.

QUESTION:

- b) Please provide the total number of projects under \$1 million (meaning, not otherwise included in Appendix 7.7, or aggregated as “other”), and the total value of these projects for each test year. Please categorize the projects totals by investment category (Sustainment, Business Ops Support, or Capacity and Growth), and by utility function (transmission, distribution, etc).
- c) Please explain how the capital spending plan will be adjusted in the event that the federal grants for Pointe Du Bois, and Portage Area Capacity Enhancement are not approved.
- d) Please File the Capital Project Justifications (CPJ), including any revisions or addendums, and Project Value Summary Reports for the following System Renewal capital projects:
 - i. Pointe Du Bois Renewable Energy Project
 - ii. System Control Center Replacement
 - iii. Limestone Units 1-3 & 5-10 Stator Rewedge
 - iv. Churchill Weir Rehabilitation
 - v. Kettle Stator Overhauls – all units
 - vi. Kettle Unit 6 Stator Overhaul
 - vii. McArthur Falls Electrical Components Replacement/Refurbishment
 - viii. Enterprise PCB Remediation
 - ix. Grand Rapids Unit 1 overhaul

- e) Please File the Capital Project Justifications (CPJ), including any revisions or addendums, and Project Value Summary Reports for the following System Efficiency capital Projects:
 - i. Jenpeg Unit 2 overhauls
 - ii. Long Spruce Overhauls – all units
- f) Please File the Capital Project Justifications (CPJ), including any revisions or addendums, and Project Value Summary Reports for the following Mandated Compliance capital Projects:
 - i. Aqua Data Collection
- g) Please File the Capital Project Justifications (CPJ), including any revisions or addendums, and Project Value Summary Reports for the following System Load Capacity capital Projects:
 - i. Portage Area Capability Enhancement
 - ii. DeSalaberry – Letellier 230 kV Transmission Line
 - iii. Laverendrye - St. Vital 230kV Line and Breakers
 - iv. Southwest Winnipeg 115 kV Transformer Improvement Phase 2
- h) Please provide greater detail on the Project approval process, the levels of approval, and expenditure signing authorities granted to each level, and the documentation reviewed at each level of approval.

RESPONSE:

b) Please see the following table for the number of projects and programs under \$1 million included as Other for 2022/23 and the Test Years.

<i>\$ in millions</i>	Number of Projects & Programs in the Other Line	2022/23 Forecast	2023/24 Preliminary Budget	2024/25 Preliminary Budget
Sustainment				
System Renewal				
Generation	55	16.1	1.6	1.5
Transmission	18	11.9	5.4	4.0
Distribution	7	6.5	0.9	0.8
	80	\$34.5	\$7.9	\$6.4
System Efficiency				
Generation	14	1.9	1.0	1.3
Transmission	9	3.5	2.2	2.2
Distribution	6	1.5	0.7	0.7
	29	\$6.8	\$3.9	\$4.2
Mandated Compliance				
Generation	4	1.2	1.2	1.7
Transmission	5	0.8	0.1	0.1
Distribution	1	0.2	-	-
	10	\$2.2	\$1.4	\$1.8
Decommissioning				
Generation	1	0.1	-	-
Transmission	4	1.0	0.9	0.9
Distribution	5	2.4	1.0	1.0
	10	\$3.5	\$1.8	\$1.9
Sustainment Total	129	\$47.0	\$15.0	\$14.2
Capacity & Growth				
System Load Capacity				
Transmission	6	3.2	0.7	0.8
Distribution	14	6.3	0.1	(0.0)
	20	\$9.5	\$0.8	\$0.8
Customer Connections				
Transmission	2	(0.2)	0.2	-
Distribution	7	2.7	-	-
	9	\$2.4	\$0.2	\$0.0
Capacity & Growth Total	29	\$11.9	\$1.0	\$0.8
Business Operations Support				
Corporate Facilities				
Corporate Infrastructure	8	5.5	0.4	0.4
	8	\$5.5	\$0.4	\$0.4
Information Technology				
Digital & Technology	6	9.1	-	-
	6	\$9.1	\$0.0	\$0.0
Town site Infrastructure				
Generation	9	8.9	0.6	0.5
	9	\$8.9	\$0.6	\$0.5
Tools and Equipment				
Transmission	3	1.9	1.3	1.3
Distribution	1	0.2	0.2	0.2
Corporate Infrastructure	1	0.4	0.4	0.4
	5	\$2.5	\$1.9	\$1.9
Business Operations Support Total	28	\$26.0	\$2.8	\$2.8
OTHER PROJECTS & PROGRAMS TOTAL	186	\$84.9	\$18.8	\$17.8

- c) In the event that Manitoba Hydro does not receive federal grants for the Pointe du Bois Renewable Energy Project and/or the Portage Area Capacity Enhancement Project, a modified cost estimate for the project would be established. The project(s) would then be subject to portfolio optimization to determine the new optimized start date for those projects and/or any deferrals necessary to maximize portfolio value, as outlined in Tab 7, Section 7.4.3.
- d) See MIPUG/MH I-82d Attachment 1 for a copy of the Capital Project Justifications (CPJ) and addendums for the requested projects in i. to ix. Please note that Project Value Summary Reports are not created separately for each investment.
- e) See MIPUG/MH I-82-e Attachment 1 for a copy of the CPJ and addendums for the requested projects in i. to ii. Please note that Project Value Summary Reports are not created separately for each investment.
- f) See MIPUG/MH I-82-f Attachment 1 for a copy of the CPJ and addendums for the requested projects in i. Please note that Project Value Summary Reports are not created separately for each investment.
- g) See MIPUG/MH I-82-g Attachment 1 for a copy of the CPJ and addendums for the requested projects in i. to iv. Please note that Project Value Summary Reports are not created separately for each investment.
- h) Section 7.4.1.1 of Tab 7 outlines how a Project is identified and prioritized. Once it reaches the approval stage, the Capital Investment Justification (CIJ) document is used to request approval for the capital investment. The approval of a CIJ, and any required amendments, ensures the investment is aligned with the strategic direction and capital requirements of the corporation.

Levels of approval and expenditure signing authorities are shown in the table below:

TOTAL PROJECT COST (GROSS OF CONTRIBUTIONS)						
Dollar Value \$						
Approval Levels	≥ 50 000 000	≥ 25 000 000 & < 50 000 000	≥ 15 000 000 & < 25 000 000	≥ 2 000 000 & < 15 000 000	≥ 1 000 000 & < 2 000 000	< 1 000 000
MHEB Audit & Finance Committee	X					
CEO		X				
CFO			X			
Vice-President				X		
Director					X	
Department Manager						X

C55-CIC-AD

**CAPITAL INVESTMENT CONCEPT ADDENDUM
FOR**

**Pointe du Bois Generating Station Life Assessment
Investment Type (Project)
Addendum Number 2**

	<u>PREVIOUSLY APPROVED</u>	<u>REVISED</u>	<u>INCREASE / (DECREASE)</u>
SCOPE DEVELOPMENT:	\$836	\$1,512	\$676
CONCEPT ESTIMATE (incl. Scope Development):	\$836	\$326,657	\$325,821
CONTRIBUTIONS:	\$0	\$0	\$0
NET CONCEPT ESTIMATE (incl. Scope Development):	\$836	\$326,657	\$325,821
	(values listed above are in thousands of dollars)		
CORPORATE VALUE		Value: N/A	Value: 187,233
FRAMEWORK SCORE :		Value/\$K: N/A	Value/\$K: 0.81

DATE PREPARED: 2019/01/07

**EC/MHEB APPROVAL MINUTE &
DATE:** CAMEC-January 22/19

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
MIDFORD, LORNE	VP GENERATION & WHOLESALE		VP Generation & Wholesale	2019/01/16
TURNER, HAL	DIRECTOR GENERATION ASSET MANAGEMENT		Director - Generation Asset Management	2019/01/15
MILES, TERRY	DIRECTOR POWER PLANNING		Director - Power Planning	2019/01/15
BISHOP, GARY	GEN ASSET STRATEGY & PERF DEPT MANAGER		Generation Asset Strategy and Performanc	2019/01/14
DRIVER, ANGIE	RESOURCE PLANNING DEPARTMENT MANAGER		Resource Planning	2019/01/11
JENSEN, ROB	ACTING AIP SECTION HEAD		Generation Asset Strategy and Performanc	2019/01/11
Johnson, Erin	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2019/01/11
ALLARD, KATHLEEN	ASSET INVESTMENT PLANNING SECTION HEAD		Generation Asset Strategy and Performanc	2019/01/07
ALLARD, KATHLEEN	ASSET INVESTMENT PLANNING SECTION HEAD		Generation Asset Strategy and Performanc	2019/01/07

ADDENDUM NUMBER	DATE	REVISION (Summary of change)

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Generation & Wholesale	REQUESTING OPERATING/CORPORATE GROUP:	Generation & Wholesale
RESPONSIBLE DIVISION:	Generation Asset Management	REQUESTING DIVISION:	Generation Operations and
RESPONSIBLE DEPARTMENT:	Generation Project Management	ISD: (YYYY/MM/DD)	2020/03/30
I.M. NODE NUMBER:	2.1.20.15.02.57	W.B.S. NUMBERS:	P:28206
C55 INVESTMENT CODE:	11676		
SAP PROJECT TYPE:	23 – BOC – Corporate Asset Management Executive Committee	C55 INVESTMENT SUB-CATEGORY:	Shell
CORPORATE INVESTMENT CATEGORIZATION:	(Level 1) C3 / Sustainment (Level 2) CM / System Renewal		

CONTACTS

PREPARED BY:	ALLARD, KATHLEEN ASSET INVESTMENT PLANNING SECTION HEAD 51455	REQUESTOR:	Gary Bishop (GW Portfolio Manager)
PROJECT MANAGER:	ST. LAURENT, MARC SECTION HEAD 50950		

MANITOBA HYDRO
CAPITAL INVESTMENT CONCEPT ADDENDUM
Point du Bois Generation Station Life Assessment

RECOMMENDATION

Increase the budget by \$0.7M to \$1.5M for the scope development phase to include a transmission study and the completion of the comprehensive assessment of the life cycle alternatives for the Pointe du Bois powerhouse.

SCOPE

The scope development includes a preliminary scope, schedule and cost estimate for each potential alternative for the future of the powerhouse and supporting infrastructure.

A transmission study will be conducted to confirm that the alternatives do not require construction of a new transmission line to the Whiteshell Station when the P lines reach end of life in 2030.

BACKGROUND

Scope development to support the life cycle decision is 85% complete. Further economic analysis and evaluation of alternatives may be required because the economics for the unit replacement alternatives would erode if the new transmission line is required.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

JUSTIFICATION

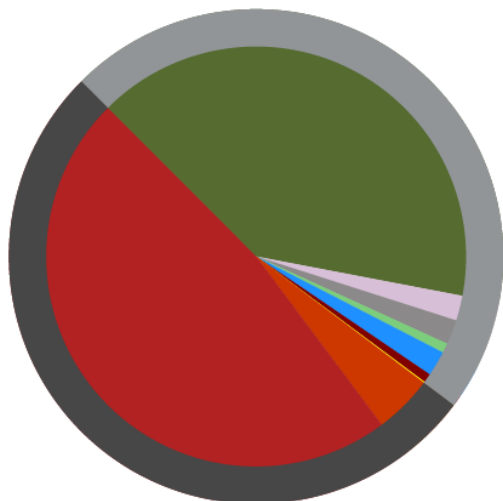
The economic viability of ongoing investment in the generating facilities at Pointe du Bois became less conclusive as the result of:

- Costs to upgrade the powerhouse and replace the units increased;
- Difficulty identifying the impacts on transmission and distribution systems;
- A decrease in the value of generation; and
- The 2016 high level cost estimate for decommissioning

Costs to gather more detailed information to confirm scope, schedule, implications, and risks of all alternatives to make an informed decision on the overall life cycle plan of the Generating Station came in greater than originally anticipated. Much of the additional budget identified are sunk costs for the alternatives crafted and the remaining 15% of effort required will be to justify the alternatives identified systemically and optimize to determine the recommended alternative and start date for execution.

Capital Investment Concept Addendum

CORPORATE VALUE FRAMEWORK (REVISED)



Value Measure	Value Points	% of Value
Capital Financial Benefits	391,475	53.15%
Safety Risk	18,734	2.54%
Stakeholder Perception Risk	18,542	2.52%
Compliance Risk	18,348	2.49%
Environmental Risk	7,133	0.97%
Financial Risk	6,639	0.9%
O&M Financial Benefits	848	0.12%
O&M Costs	-43,662	5.93%
Total Cost	-230,824	31.34%
Total Value	187,233	
Value/\$K	0.81	

Capital Investment Concept Addendum

OTHER ALTERNATIVES CONSIDERED

Alternatives will be developed and addressed within the Evaluation. No additional alternatives have been identified as a result of this addendum

INVESTMENT RISK ANALYSIS

No additional investment risks have been identified as a result of this addendum.

MANITOBA HYDRO
CAPITAL INVESTMENT CONCEPT ADDENDUM
Point du Bois Generation Station Life Assessment

ESTIMATED COST FLOW											
The annual projected cost flows are as follows (in thousands of dollars):											
PREVIOUSLY APPROVED				PROPOSED				INCREASE/ (DECREASE)			
Fiscal Year	Scope Development Funds	Concept Estimate	Total Estimated Investment (Net of Contrib.)	Scope Development Funds	Concept Estimate	Total Estimated Investment (Net of Contrib.)	Scope Development Funds	Concept Estimate	Total Estimated Investment (Net of Contrib.)		
Prev. Actuals	\$432	\$0	\$432	\$931	\$0	\$931	\$499	\$0	\$499		
2018/2019	\$404	\$0	\$404	\$432	\$0	\$432	\$28	\$0	\$28		
2019/2020	\$0	\$0	\$0	\$149	\$0	\$149	\$149	\$0	\$149		
2020/2021	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0		
2021/2022	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0		
2022/2023	\$0	\$0	\$0	\$0	\$5,942	\$5,942	\$0	\$5,942	\$5,942		
2023/2024+	\$0	\$0	\$0	\$0	\$319,203	\$319,203	\$0	\$319,203	\$319,203		
Total	\$836	\$0	\$836	\$1,512	\$325,145	\$326,657	\$676	\$325,145	\$325,821		

IMPACT ON O&A COSTS
No additional O&A costs have been identified as a result of this addendum.

MANITOBA HYDRO
CAPITAL INVESTMENT CONCEPT ADDENDUM
Point du Bois Generation Station Life Assessment

RELATED INVESTMENTS

N/A

REFERENCE DOCUMENTS

[DAD_PDB_GS_STUDY.docm](#)

[11676_CIC_AD_PDB_GS_SCOPE_DEVELOPMENT_1.docx](#)

[Financial Chart PDB Life Assessment CICa2 November 2018.xlsx](#)

C55-CIC-AD

**CAPITAL INVESTMENT CONCEPT ADDENDUM
FOR**

**Pointe du Bois 8 Unit Replacement
Investment Type (Project)
Addendum Number 3**

	<u>PREVIOUSLY APPROVED</u>	<u>REVISED</u>	<u>INCREASE / (DECREASE)</u>
SCOPE DEVELOPMENT:	\$1,512	\$2,704	\$1,192
CONCEPT ESTIMATE (incl. Scope Development):	\$326,657	\$186,409	\$184,897
CONTRIBUTIONS:	\$0	\$0	\$0
NET CONCEPT ESTIMATE (incl. Scope Development):	\$326,657	\$186,409	\$184,897
			(values listed above are in thousands of dollars)
CORPORATE VALUE FRAMEWORK SCORE:	Value: N/A	Value: 134,327	
	Value/\$K: N/A	Value/\$K: 0.89	
			(CFV scores reflect the recommended alternative)

DATE PREPARED: 2021-04-15

**EC/MHEB APPROVAL MINUTE &
DATE:**

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
Midford, Lorne	VP ASSET PLANNING & DELIVERY		VP Asset Planning & Delivery	2021-05-05
Turner, Hal	DIRECTOR ASSET MANAGEMENT		Director - Asset Management	2021-05-04
Halayko, Krista	ASSET MGMT STRATEGY & PLANNING DEPT MGR		Asset Management Strategy & Planning	2021-05-03
Pawluk, James	GENERATION PROJECT MANAGEMENT DEPT MGR		Generation Project Management	2021-04-28
Johnson, Erin	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2021-04-28
Edwards, Alaina	PROJECT CONTROL & REPORTING OFFICER		Generation Project Management	2021-04-16
Allard, Kathleen	PORTFOLIO PLANNER		Asset Management Strategy & Planning	2021-04-15

ADDENDUM NUMBER	DATE	REVISION (Summary of change)
Original	2017/03/10	Develop a plan to decommission the generating facilities at Pointe du Bois, while maintaining long term spillway operation, and the criteria for when decommissioning would occur.
1	2018/01/22	Approve a \$336 increase in budget for the scope development of alternatives to be considered for the Pointe du Bois powerhouse and establish the criteria for timing its decommissioning.
2	2019/01/16	Increase the budget by \$0.7M to \$1.5M for the scope development phase to include a transmission study and the completion of the comprehensive assessment of the life cycle alternatives for the Pointe du Bois powerhouse.

CAPITAL INVESTMENT MASTER DATA

RESPONSIBLE OPERATING/CORPORATE GROUP:	Asset Planning & Delivery	REQUESTING OPERATING/CORPORATE GROUP:	Asset Planning & Delivery
RESPONSIBLE DIVISION:	Asset Management	REQUESTING DIVISION:	Integrated Resource Planning
RESPONSIBLE DEPARTMENT:	Asset Management Strategy & Asset	ISD: (YYYY/MM/DD)	2021/09/30
I.M. NODE NUMBER:	2.1.20.15.02.57	W.B.S. NUMBERS:	P:28206
C55 INVESTMENT CODE:	11676		
SAP PROJECT TYPE:	24 - BOC - VP & Management	C55 INVESTMENT SUB-CATEGORY:	Shell
CORPORATE INVESTMENT CATEGORIZATION:	(Level 1) C3 / Sustainment (Level 2) CM / System Renewal		

CONTACTS

PREPARED BY:	Allard, Kathleen PORTFOLIO PLANNER 51930	REQUESTOR:	Marc St. Laurent SECTION HEAD 50950
PROJECT MANAGER:	Pawluk, James GENERATION PROJECT MANAGEMENT DEPT MGR 51460		

MANITOBA HYDRO
CAPITAL INVESTMENT CONCEPT ADDENDUM
Pointe du Bois 8 Unit Replacement

RECOMMENDATION

Increase the budget by \$1.2M to a total of \$2.7M for the scope development stage. The remaining scope development will redirect focus on the successful installation of 8 new generating units. The estimated schedule for the scope development stage anticipates that the investment will be advanced to executing by December 2021.

SCOPE

The remainder of the scope development stage will include:

- Defining the boundaries of the scope required to ensure the ability to install 8 new units at the Pointe du Bois Generating station. Scope boundaries include the remaining demolition and removal of existing equipment as well as the upgrades of auxiliary and ancillary equipment necessary to successfully install, commission and place into service the new unit. Scope boundaries will be limited to exclude activities that are not required to put the new units into service;
- The refinement of a project plan including a detailed estimate of budget and schedule; supply and installation procurement strategy; and a detailed schedule and risk mitigation plan;
- Detailed investment evaluation within the corporate value framework;
- Environmental assessment and regulatory licensing for 8 new units;
- An approved Capital Investment Justification (CIJ).

BACKGROUND

Scope Development to date has included various facility assessments and an economic analysis of life cycle alternatives which supports the continued operation and investment into the Point du Bois Generating Station. The economic analysis also determined that replacing generating units would be economically attractive. The attractive economics along with minimal environmental impacts lead to an application to receive funding from the Federal Investing in Canada Infrastructure Program for the installation of eight new units.

Currently there are 6 of 16 units that normally operate with expected remaining life ranging from minimal (high risk of imminent failure) to 2050s. Installation of new units was deemed valuable and optimized to proceed in 2015 when originally promoted for potential execution but was deferred due to uncertainty with the future operational requirement of the plant. The investment continues to prove valuable and the federal funding support further strengthens the economics and the justification to expedite the planning and implementation of new units.

It is anticipated that by early 2030s three of the existing units will reach end of economic life, three of the existing units are currently performing at an acceptable reliability and expected to operate until 2050s along with the proposed new units.

Capital Investment Concept Addendum

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

JUSTIFICATION

- The Pointe du Bois Unit Replacement Project provides Manitoba Hydro an opportunity to increase system capacity by 52 megawatts (MW) and increase the annual amount of clean, renewable energy generated at the Pointe du Bois Generating Station. The Project would install 8 new generating units that would produce 380 gigawatt hours (GWh) per year, on average, between 2024 and 2055. The investment is expected to reduce approximately 9 megatonnes of global greenhouse gas emissions by 2055.

The cost of energy produced by the Project would be lower than new thermal generation resource options and comparable or lower than new wind and solar generation. The hydro units will have a high capacity factor resulting in a firm source of power to meet peak loads which provides an additional firm power/reliability benefit. The firm power source is more beneficial than the intermittent generation from solar and wind. This low-cost renewable firm energy project supports Manitoba Hydro's 2040 Strategic Plan to keep costs as low as possible while making the investments necessary to serve Manitobans.

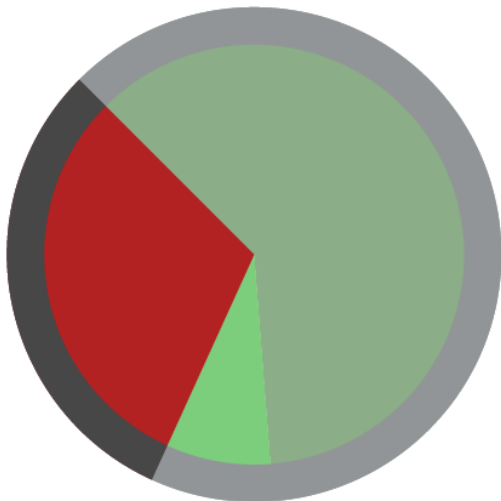
The Project aligns with several Federal climate and energy policies/objectives that aim at reducing GHG emitting electricity generation, expanding the supply of non-emitting electricity, and/or encouraging electrification. This additional non-emitting generation resource will assist in mitigating future load growth risk and support corporate and provincial goals to reduce greenhouse gas emissions.

Execution of this investment is expected to return the following measurable value:

- Generation Revenue Benefit - Increase system capacity and energy
- Financial risk - replacement of the units will reduce the likelihood of more serious failures, which could result in collateral damage
- Safety - modernized systems will improve operability, reduce risk of failure during operation
- O&M benefit - modernized systems will reduce the O&M costs associated with maintaining operation and conducting repairs
- Environmental Risk Mitigation – New units will restore water flow through the powerhouse closer to the original powerhouse design (originally 16 units) reducing environmental impacts of continued degradation of existing units

Capital Investment Concept Addendum

CORPORATE VALUE FRAMEWORK (REVISED)



Value Measure	Value Points	% of Value
Generation Revenue Benefit	246,514	61.27%
Environmental Risk	38,769	8.03%
Total Cost	-150,956	30.7%
Total Value	134,327	
Value/\$K	0.89	

Capital Investment Concept Addendum

OTHER ALTERNATIVES CONSIDERED

There are no other alternatives to consider at this time with the uncertainty of the scope of work eligible for the federal funding application and the successful installation of the units.

Benefits and risks associated with permutations and combinations of the various unit supply proposals will be presented in the justification of the scope in the CIJ prior to executing and the justification for vendor selection.

INVESTMENT RISK ANALYSIS

There is a small risk that the federal funding application and estimated cost will not reveal value to proceed with the project as originally planned. If this occurs, project scope will be reconsidered and if value cannot be measured the cost incurred will need to be expensed.

MANITOBA HYDRO
CAPITAL INVESTMENT CONCEPT ADDENDUM
Pointe du Bois 8 Unit Replacement

ESTIMATED COST FLOW									
The annual projected cost flows are as follows (in thousands of dollars):									
	PREVIOUSLY APPROVED			PROPOSED			INCREASE/ (DECREASE)		
Fiscal Year	Scope Development Funds	Concept Estimate	Total Estimated Investment (Net of Contrib.)	Scope Development Funds	Concept Estimate	Total Estimated Investment (Net of Contrib.)	Scope Development Funds	Concept Estimate	Total Estimated Investment (Net of Contrib.)
Prev. Actuals	\$1,512	\$1,512	\$1,512	\$1,629	\$1,629	\$1,629	\$117	\$117	\$117
2021/2022	\$0	\$0	\$0	\$1,074	\$1,683	\$1,683	\$1,074	\$1,683	\$1,683
2022/2023	\$0	\$5,942	\$5,942	\$0	\$4,159	\$4,159	\$0	(\$1,783)	(\$1,783)
2023/2024	\$0	\$26,732	\$26,732	\$0	\$32,641	\$32,641	\$0	\$5,909	\$5,909
2024/2025	\$0	\$41,850	\$41,850	\$0	\$46,665	\$46,665	\$0	\$4,815	\$4,815
2025/2026	\$0	\$82,225	\$82,225	\$0	\$43,608	\$43,608	\$0	(\$38,617)	(\$38,617)
2026/2027+	\$0	\$168,396	\$168,396	\$0	\$56,024	\$56,024	\$0	(\$112,372)	(\$112,372)
Total	\$1,512	\$326,657	\$326,657	\$2,704	\$186,409	\$186,409	\$1,192	(\$140,248)	(\$140,248)

IMPACT ON O&A COSTS
No additional O&A costs have been identified as a result of this addendum.

MANITOBA HYDRO
CAPITAL INVESTMENT CONCEPT ADDENDUM
Pointe du Bois 8 Unit Replacement

RELATED INVESTMENTS

N/A

REFERENCE DOCUMENTS

[DAD_PDB_GS_STUDY.docm](#)

[11676_CIC_AD_PDB_GS_SCOPE_DEVELOPMENT_1.docx](#)

[Financial Chart PDB Life Assessment CICa2 November 2018.xlsx](#)

[11676_CIC_AD_PDB_GS_Life_Assessment_\(Shell\)_2.docx](#)

[Financial Chart -Pointe du Bois 8 Unit Replacement CICa3.xlsx](#)

C55-CIC-AD

**CAPITAL INVESTMENT CONCEPT ADDENDUM
FOR**

**Pointe du Bois Renewable Energy Project
Investment Type (Project)
Addendum Number 4**

	<u>PREVIOUSLY APPROVED</u>	<u>REVISED</u>	<u>INCREASE / (DECREASE)</u>
SCOPE DEVELOPMENT:	\$2,704	\$7,950	\$5,247
CONCEPT ESTIMATE (incl. Scope Development):	\$185,144	\$392,396	\$207,252
CONTRIBUTIONS:	\$0	(\$114,000)	(\$114,000)
NET CONCEPT ESTIMATE (incl. Scope Development):	\$185,144	\$278,396	\$93,252
			(values listed above are in thousands of dollars)
CORPORATE VALUE FRAMEWORK SCORE:	Value: 29,547	Value: 32,556	
	Value/\$K: 0.10	Value/\$K: 0.14	
			(CVF scores reflect the recommended alternative)

DATE PREPARED: 2022-09-02

**EC/MHEB APPROVAL MINUTE &
DATE:**

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
Turner, Hal	VP ASSET PLANNING & DELIVERY		VP Asset Planning & Delivery	2022-09-29
Pawluk, James	DIRECTOR ASSET MANAGEMENT		Director - Asset Management	2022-09-27
Ward, Ryan	DIRECTOR PROJECT MANAGEMENT		Director Project Management	2022-09-26
Halayko, Krista	ASSET MGMT STRATEGY & PLANNING DEPT MGR		Asset Management Strategy & Planning	2022-09-22
Orellana, Cristian	GENERATION PROJECTS DEPARTMENT MANAGER		Generation Projects	2022-09-16
Johnson, Erin	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2022-09-15
Swait, Caitlin	FINANCIAL SERVICES LEAD - GEN PROJECTS		Project Services	2022-09-09
Dlot, Aaron	ASSET INVESTMENT PLANNING SECTION		Asset Management Strategy & Planning	2022-09-02

ADDENDUM NUMBER	DATE	REVISION (Summary of change)
CIC	2017/03/10	Develop a plan to decommission the generating facilities at Pointe du Bois, while maintaining long term spillway operation, and the criteria for when decommissioning would occur.
1	2018/01/22	Approve a \$336 increase in budget for the scope development of alternatives to be considered for the Pointe du Bois powerhouse and establish the criteria for timing its decommissioning.
2	2019/01/22	Increase the budget by \$0.7M to \$1.5M for the scope development phase to include a transmission study and the completion of the comprehensive assessment of the life cycle alternatives for the Pointe du Bois powerhouse.
3	2021/05/05	Increase the budget by \$1.2M to a total of \$2.7M for the scope development stage. The remaining scope development will redirect focus on the successful installation of 8 new generating units. The estimated schedule for the scope development stage anticipates that the investment will be advanced to executing by December 2021.

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Asset Planning & Delivery	REQUESTING OPERATING/CORPORATE GROUP:	Asset Planning & Delivery
RESPONSIBLE DIVISION:	Project Management	REQUESTING DIVISION:	Asset Management
RESPONSIBLE DEPARTMENT:	Generation Projects	ISD: (YYYY/MM/DD)	2022/11/30
I.M. NODE NUMBER:	2.1.20.15.02.57	W.B.S. NUMBERS:	P:28206, P:35613, P:35600, P:36830, P:36831, P:35609, P:35612
C55 INVESTMENT CODE:	11676		
SAP PROJECT TYPE:	24 - BOC-VP & Management	C55 INVESTMENT SUB-CATEGORY:	Shell
CORPORATE INVESTMENT CATEGORIZATION:	(Level 1) C3 / Sustainment (Level 2) CM / System Renewal		

CONTACTS			
PREPARED BY:	Swait, Caitlin FINANCIAL SERVICES LEAD - GEN PROJECTS 51185	REQUESTOR:	Dave Hildebrand, Asset Lifecycle Management
PROJECT MANAGER:	Freeman, Keith TEAM LEADER 51460		

MANITOBA HYDRO
CAPITAL INVESTMENT CONCEPT ADDENDUM
Pointe du Bois Renewable Energy Project

RECOMMENDATION

Increase the budget by \$5.2M to a total of \$8.0M for the scope development stage. The remaining scope development will redirect focus on the initial works required for the successful installation of eight new generating units. The estimated schedule for the scope development stage anticipates that the investment will be advanced to executing by December 2022.

SCOPE

The requested increase to the CIC of \$5.2 million includes the following:

- Supply of Intake Bulkhead Gates, that are required immediately after project approval, to allow the existing units to be removed in the dry.
- Supply of site infrastructure (Office Trailer, Wash Car, Utilities) required for Manitoba Hydro staff to support a 5-year project.
- Hydraulic testing of an existing Pointe du Bois Unit for baseline performance information
- Scope Development for the Transmission component of the Project including preliminary design for station alternatives, route selection and preliminary engagement required to maintain the schedule for an Environment Act License.
- External consultant costs to complete design work that must start early in 2022 to issue Contracts that support the installation of the new generators and turbines. This work includes:
 - Technical Specifications for the upgrades on the existing cranes
 - Technical support on the evaluation of the Turbine and Generator proposals
 - Technical Specifications for the Unit Removal Contract
 - Technical Specification for the Civil Demolition/Concrete Embedment Contract
 - Technical support for the manufacturing of the Intake Bulkhead Gates
 - Internal labour cost to undertake pre-construction activities (Project Planning, RFP Preparation and pre-award activities, Project Approval Process) to maintain Project schedule dates.

BACKGROUND

Past facility assessments and an economic analysis of life cycle alternatives supports the continued operation and investment in the Pointe du Bois Generating Station. The economic analysis also determined that replacing generating units would be economically attractive. The attractive economics along with minimal environmental impacts lead to an application to receive funding from the Federal Investing in Canada Infrastructure Program for the installation of eight new units. In April 2021 Manitoba Hydro submitted a business case to the Treasury Board of Canada in order to apply for funding through the Investing in Canada Infrastructure Program (ICIP) for the Pointe du Bois Unit Replacement Project. If approved, the program will provide funding for up to 50% of eligible costs equating to approximately \$114 million out of the originally estimated \$314M million costs of the project.

In order to meet criteria to receive the full funding amount eligible under the ICIP, the project must be substantially complete by the end of October 2027. In preparation to meet these dates for the funding, project planning and

Capital Investment Concept Addendum

BACKGROUND

execution activities commenced in April 2021. The Project Team has developed a P80 estimate and schedule to be used in the Project Execution Plan. Decision Gates have been defined to align with key dates during development and execution of the project. Project execution activities need to continue to maintain the schedule and meet the October 2027 deadline to receive full funding.

Currently there are 6 of 16 units that normally operate with expected remaining life ranging from minimal (high risk of imminent failure) to 2050s. Installation of new units was deemed valuable and optimized to proceed in 2015 when originally promoted for potential execution but was deferred due to uncertainty with the future operational requirement of the plant. The investment continues to prove valuable and the federal funding support further strengthens the economics and the justification to expedite the planning and implementation of new units.

It is anticipated that by early 2030s three of the existing units will reach end of economic life, three of the existing units are currently performing at an acceptable reliability and expected to operate until 2050s along with the proposed new units.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

JUSTIFICATION

The Pointe du Bois Unit Replacement Project provides Manitoba Hydro an opportunity to increase system capacity by 52 megawatts (MW) and increase the annual amount of clean, renewable energy generated at the Pointe du Bois Generating Station. The Project would install 8 new generating units that would produce 380 gigawatt hours (GWh) per year, on average, between 2024 and 2055. The investment is expected to reduce approximately 9 megatonnes of global greenhouse gas emissions by 2055.

The cost of energy produced by the Project would be lower than new thermal generation resource options and comparable or lower than new wind and solar generation. The hydro units will have a high-capacity factor resulting in a firm source of power to meet peak loads which provides an additional firm power/reliability benefit. The firm power source is more beneficial than the intermittent generation from solar and wind.

This low-cost renewable firm energy project supports Manitoba Hydro's 2040 Strategic Plan to keep costs as low as possible while making the investments necessary to serve Manitobans.

The Project aligns with several Federal climate and energy policies/objectives that aim at reducing greenhouse gas emitting electricity generation, expanding the supply of non-emitting electricity, and/or encouraging electrification. This additional non-emitting generation resource will assist in mitigating future load growth risk and support corporate and provincial goals to reduce greenhouse gas emissions.

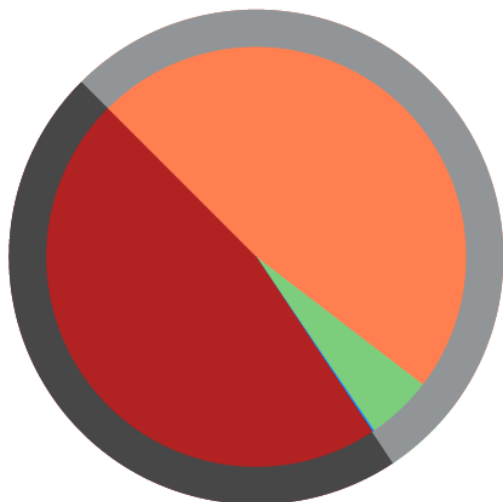
Execution of this investment is expected to return the following measurable value:

- Generation Revenue Benefit - Increase system capacity and energy
- Financial risk - replacement of the units will reduce the likelihood of more serious failures, which could result in collateral damage
- Safety - modernized systems will improve operability, reduce risk of failure during operation
- O&M benefit - modernized systems will reduce the O&M costs associated with maintaining operation and conducting repairs
- Environmental Risk Mitigation – New units will restore water flow through the powerhouse closer to the original powerhouse design (originally 16 units); will avoid global greenhouse gas emissions.

Capital Investment Concept Addendum

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

CORPORATE VALUE FRAMEWORK (REVISED)



Value Measure	Value Points	% of Value
Lost Generation Risk	243,131	47.22%
Environmental Risk	25,787	5.01%
Safety Risk	834	0.16%
Financial Risk	278	0.05%
Total Cost	-237,473	46.12%
Total Value	32,556	
Value/\$K	0.14	

Capital Investment Concept Addendum

OTHER ALTERNATIVES CONSIDERED

There are no other alternatives to consider at this time.

Benefits and risks associated with permutations and combinations of the various unit supply proposals will be presented in the justification of the scope in the CIJ prior to executing and the justification for vendor selection.

INVESTMENT RISK ANALYSIS

There is a small risk that the federal funding application and estimated cost will not reveal value to proceed with the project as originally planned. If this occurs, project scope will be reconsidered and if value cannot be measured the cost incurred will need to be expensed.

MANITOBA HYDRO
CAPITAL INVESTMENT CONCEPT ADDENDUM
Pointe du Bois Renewable Energy Project

ESTIMATED COST FLOW									
The annual projected cost flows are as follows (in thousands of dollars):									
	PREVIOUSLY APPROVED			PROPOSED			INCREASE/ (DECREASE)		
Fiscal Year	Scope Development Funds	Concept Estimate	Total Estimated Investment (Net of Contrib.)	Scope Development Funds	Concept Estimate	Total Estimated Investment (Net of Contrib.)	Scope Development Funds	Concept Estimate	Total Estimated Investment (Net of Contrib.)
Prev. Actuals	\$2,704	\$3,304	\$3,304	\$2,857	\$2,857	\$2,857	\$154	(\$447)	(\$447)
2022/2023	\$0	\$4,112	\$4,112	\$5,093	\$55,657	\$55,657	\$5,093	\$51,545	\$51,545
2023/2024	\$0	\$32,317	\$32,317	\$0	\$90,299	\$67,499	\$0	\$57,982	\$35,182
2024/2025	\$0	\$46,292	\$46,292	\$0	\$73,438	\$50,638	\$0	\$27,146	\$4,346
2025/2026	\$0	\$43,326	\$43,326	\$0	\$70,294	\$47,494	\$0	\$26,968	\$4,168
2026/2027	\$0	\$33,740	\$33,740	\$0	\$68,000	\$45,200	\$0	\$34,259	\$11,459
2027/2028+	\$0	\$22,053	\$22,053	\$0	\$31,851	\$9,051	\$0	\$9,798	(\$13,002)
Total	\$2,704	\$185,144	\$185,144	\$7,950	\$392,396	\$278,396	\$5,247	\$207,252	\$93,252

IMPACT ON O&A COSTS
No additional O&A costs have been identified as a result of this addendum.

MANITOBA HYDRO
CAPITAL INVESTMENT CONCEPT ADDENDUM
Pointe du Bois Renewable Energy Project

RELATED INVESTMENTS

N/A

REFERENCE DOCUMENTS

[11676 CIC AD PDB GS SCOPE DEVELOPMENT 1.docx](#)

[11676 CIC AD PDB GS Life Assessment \(Shell\) 2.docx](#)

[11676 CIC AD Pointe du Bois 8 Unit Replacem 3.docx](#)

[Approved - REC-PdB Unit Replacement CIC-20220706.pdf](#)

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**CAPITAL INVESTMENT JUSTIFICATION
FOR**

Pointe du Bois Renewable Energy Project

Investment Type (Project)

BUDGET:	\$422,447
CONTRIBUTIONS:	(\$114,150)
NET BUDGET:	\$308,297
(values listed above are in thousands of dollars)	
CORPORATE VALUE	Value: 76,098
FRAMEWORK SCORE:	Value/\$K: 0.28

DATE PREPARED: 2022-10-07

EC/MHEB APPROVAL MINUTE & DATE: Approved MHEB Minute
952.10 on October 28, 2022

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
Turner, Hal	VP ASSET PLANNING & DELIVERY		VP Asset Planning & Delivery	2022-10-20
Pawluk, James	DIRECTOR ASSET MANAGEMENT		Director - Asset Management	2022-10-14
Ward, Ryan	DIRECTOR PROJECT MANAGEMENT		Director Project Management	2022-10-13
Halayko, Krista	ASSET MGMT STRATEGY & PLANNING DEPT MGR		Asset Management Strategy & Planning	2022-10-13
Orellana, Cristian	GENERATION PROJECTS DEPARTMENT MANAGER		Generation Projects	2022-10-11
Johnson, Erin	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2022-10-11
Swait, Caitlin	FINANCIAL SERVICES LEAD - GEN PROJECTS		Project Services	2022-10-07
Dlot, Aaron	ASSET INVESTMENT PLANNING SECTION HEAD		Asset Management Strategy & Planning	2022-10-07

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Asset Planning & Delivery	REQUESTING OPERATING/CORPORATE GROUP:	Asset Planning & Delivery
RESPONSIBLE DIVISION:	Project Management	REQUESTING DIVISION:	Asset Management
RESPONSIBLE DEPARTMENT:	Generation Projects	ISD: (YYYY/MM/DD)	2027/03/31
I.M. NODE NUMBER:	2.1.20.15.02.57	W.B.S. NUMBERS:	P:28206, P:35600, P:37848, P:37847
C55 INVESTMENT CODE:	11676		
SAP PROJECT TYPE:	21 - BOC-MHEB Audit & Finance Committee	C55 INVESTMENT SUB-CATEGORY:	Shell
CORPORATE INVESTMENT CATEGORIES:	(Level 1) C3 / Sustainment (Level 2) CM / System Renewal		

CONTACTS			
PREPARED BY:	Swait, Caitlin FINANCIAL SERVICES LEAD - GENERATION PROJECTS 51185	REQUESTOR:	Dave Hildebrand, Asset Lifecycle Management
PROJECT MANAGER:	Freeman, Keith TEAM LEADER 51460		

MANITOBA HYDRO
CAPITAL INVESTMENT JUSTIFICATION
Pointe du Bois Renewable Energy Project

RECOMMENDATION

Approve funding of \$308.3 million for the Pointe du Bois Renewable Energy Project to replace units 2, 3, 4, 5, 7, 8, 9 and 11 and all associated Transmission upgrades.

SCOPE

The scope of work includes:

- Supply of intake bulkheads
- Supply of site infrastructure (office trailer, washcar, utilities, bird exclusion)
- Upgrades to the turbine and generator hall cranes
- Removal of four (4) existing units
- Civil demolition, generator base modifications and concrete embedment installation required for new Units
- 115kV Transmission Line from Pointe du Bois Generating Station to Whiteshell Station (PW75)
- Infrastructure at the Whiteshell Station and at the Pointe du Bois Switchyard Station (outlined in Investment 13854)
- Removal of the existing 66 kV Transmission Lines P3 & P4 between Lee River Distribution Supply Centre (DSC) and Pointe du Bois Station
- Supply and installation of 8 new turbine and generator units including:
 - Units 2, 3, 4, 5, 7, 8, 9, 11
 - Excitation system
 - Protection system
 - Generator Switch Gear
 - Unit Control & Monitoring system
 - Governor system
- Station service upgrades
- Generator Step-Up transformer replacement (2)
- 129V DC Upgrades
- Remote Terminal Unit Replacement
- Installation of Intake Wheeled Gates
- Trashrack Upgrades
- Turbine Pit Wall Refurbishments
 - Brick removal
 - Grouting
 - Siding Installation

BACKGROUND

Of the original 16 units at Pointe du Bois, 6 remain in operation with the other 10 units at end of life (6 units are permanently out of service and 4 units have been removed from the station). Three of the operational units have a near-term end of life, while the other three operational units are performing at an acceptable reliability and are expected to remain up to the 2050s. The installation of 8 new units will restore some of the generation capacity at this station. The benefits of this project and the federal funding deadline provide justification to expedite the

BACKGROUND

planning and implementation of new units.

An interconnection evaluation study was completed October 2021 and identified that a new 115kV transmission line (PW75) from Pointe du Bois Station to Whiteshell Station was required to accommodate the increased generation output from the generating station. In addition to accommodating the increased generation from Pointe du Bois this line will eliminate the need to build alternative transmission infrastructure in the future. The existing P3 and P4 lines will be salvaged from Pointe du Bois to Lee River DSC and this section right-of way will be re-used for PW75. The portion of PW75 from Lee River DSC to the Whiteshell Station will be located on a new right-of-way and will require a route segment analysis to determine a preferred route. The new transmission line will also be used to transmit power from Slave Falls Generating Station and to serve local load in the long term.



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JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

JUSTIFICATION

Execution of this investment is expected to return the following measurable value:

Generation Revenue Benefit (including benefits for deferral of future capacity and energy investments)

- The Project would increase system capacity by 54 megawatts (MW) and increase the annual amount of clean, renewable energy generated at the Pointe du Bois Generating Station. The 8 new generating units would produce on average 380 gigawatt hours (GWh) per year between 2024 and 2055.
- The cost of energy produced by the Project would be lower than new thermal generation resource options and comparable to or lower than new wind and solar generation. The hydro units will have a high capacity factor resulting in a dispatchable source of power that can serve peak loads. The dispatchable generation source is more beneficial than the intermittent generation from solar and wind.

Capital Financial Benefit

- The new 115 kV transmission line will avoid other long term transmission investments that would be required to serve local load growth.

Other Benefits

- The project has an incremental net present value, with the ICIP Funding, of \$90M and \$50M, for cost estimates with P50 and P80 levels of confidence respectively, incorporating both cost and schedule risks. The value is incremental to the alternative of advancing other generation resources to meet future load growth assuming Pointe du Bois GS operates to 2055.
- The generation resulting from this renewable energy source will qualify for Renewable Energy Credits which are a tradable commodity that provides an additional source of revenue.

Environmental Risk

- The investment is expected to reduce approximately 9 megatonnes of global greenhouse gas emissions by 2055 or 250,000 tonnes each year. The Project aligns with several federal climate and energy policies and objectives that aim at reducing GHG emitting electricity generation, expanding the supply of non-emitting

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

electricity, and/or encouraging electrification. This additional non-emitting generation resource will assist in mitigating future load growth risk and supports corporate and provincial goals to reduce greenhouse gas emissions.

Safety Risk

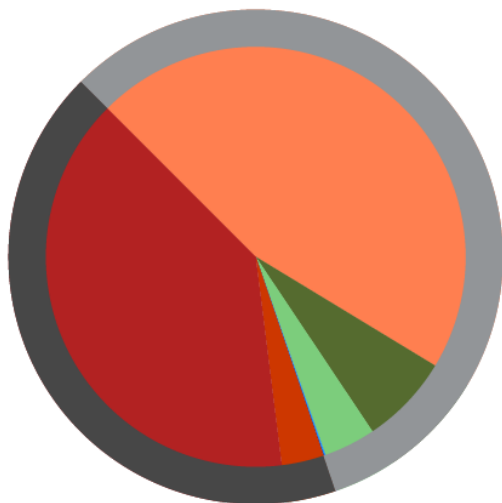
- Modernized systems will improve worker safety, operability and reduce risk of failure during operation.

O&M Cost

- The operation and maintenance costs will increase by \$1.3 million per year as there will be more units in operation than the current state.

Capital Investment Justification

CORPORATE VALUE FRAMEWORK



Value Measure	Value Points	% of Value
Generation Revenue Benefit	298,038	44.93%
Capital Financial Benefits	44,814	6.75%
Environmental Risk	25,787	3.89%
Safety Risk	834	0.00%
Financial Risk	278	0.00%
O&M Costs	-20,837	3.14%
Total Cost	-272,816	41.12%
Total Value	76,098	
Value/\$K	0.28	

Capital Investment Justification

ANALYSIS OF ALTERNATIVES:

ECONOMIC ANALYSIS		
Discount Rate	For current corporate rates see P911 6%	

Active Option	NPV Benefits/(Costs)	CVF Score	Value/\$K
Recommended		76,098	0.28

Other Alternatives	NPV Benefits/(Costs)	CVF Score	Value/\$K
See Other Alternatives Considered section			

INVESTMENT RISK ANALYSIS

Risk registers were created to determine specific risks associated with the Transmission and Generation components of the project. The specific risks highlight potential problems associated with physical conditions, supply/financial markets, project interfaces, environmental/permit issues, project execution and commissioning. The risk evaluation also considers broad risks such as corporate maturity, project planning, estimate/schedule quality, estimate/schedule competitiveness, PM effectiveness and technical/execution complexity. The risks were quantified as to the cost and schedule impacts and then the residual risk was quantified after mitigation efforts were applied. The top 5 residual risks for the Generation component of the Project include:

- Community consultation and the requirement for Free, Prior and Informed Consent (FPIC) may cause project delays
- Supply Chain disruptions resulting in materials/equipment not arriving on time causing impacts to project budget and timeline
- Subsurface or conditions underneath concrete structure are unknown
- Market turmoil due to political tension, corona virus, major weather events affecting industrial commodity (steel, copper, resin) prices and project schedule.
- Systemic risks with large scale projects may reveal new scope

The top 5 residual risks for the Transmission component of the Project include:

- Delays in receiving licensing resulting in a delay to the start of construction
- Uncertain scope associated with the control building expansion/new construction at the Pointe du Bois Switching Station that is required for this project may cause budget/schedule issues
- Unforeseen route changes may increase structure costs as a result of additional structures needed
- Geotechnical conditions require a change to the existing foundation design to a more expensive micro-pile foundations
- Increased property costs due to the route segment analysis recommending a preferred route on private land

A detailed risk review was completed for the Generation and Transmission components of the Project covering systemic and project specific risks. The results of the risk analysis are as follows:

Capital Investment Justification

INVESTMENT RISK ANALYSIS

P50 Cost Contingency \$39.92 M
P80 Cost Contingency \$83.82 M

The Project will be funded at the P80 level.

A risk analysis was undertaken for the economic evaluation which showed that the project would continue to be more economical than the alternative without the project even if the risks materialized. Risks considered include lower than forecast opportunity export prices, higher than expected cost, higher than forecast discount rate and lower than expected generating unit performance.

ESTIMATED COST FLOW

The annual projected cost flows are as follows (in thousands of dollars):

Fiscal Year	Budget	Contributions	Net Budget
Prev. Actuals	\$2,857	\$0	\$2,857
2022/2023	\$43,085	(\$5,150)	\$37,935
2023/2024	\$84,282	(\$32,151)	\$52,131
2024/2025	\$101,843	(\$37,113)	\$64,730
2025/2026	\$81,805	(\$35,951)	\$45,854
2026/2027	\$91,673	(\$3,785)	\$87,888
2027/2028+	\$16,902	0	\$16,902
Total	\$422,447	(\$114,150)	\$308,297

IMPACT ON O&A COSTS

The completion of this project is anticipated to result in an increase in operating and administrative expenses equal to \$1.3 million per year as there will be more units to operate/maintain than are currently in-service.

PROPOSED SCHEDULE

The Project will begin in late 2022 and is scheduled to be complete by June of 2027. The Proposed in-service dates of each Unit are as follows:

- First Unit – December 2024
- Second Unit – February 2025
- Third Unit – September 2025
- Fourth Unit – October 2025
- Fifth Unit – May 2026
- Sixth Unit – July 2026
- Seventh Unit – January 2027
- Eight Unit – March 2027

Capital Investment Justification

PROPOSED SCHEDULE

PW75 Available August 2026

RELATED INVESTMENTS

Pointe du Bois 8 Unit Replacement CIC P:28206
13854 – Pointe du Bois Transmission

OTHER ALTERNATIVES CONSIDERED

There are no other alternative means of executing this project to consider at this time that would meet the requirements of the ICIP funding.

The alternative to carrying out this project is to continue to invest in powerhouse life extension upgrades to enable continued operation of existing units until the 2050s. This alternative delays construction of the new 115kV transmission line to the 2050s to provide generation outlet transmission for Slave Falls Generating Station and to serve local load in the long term. Another alternative that was considered was continued operation of the powerhouse to 2030 followed by decommissioning. Both alternatives would require other generation resources to be developed to meet future load growth and the associated investments to be advanced. All alternatives include new energy and capacity resources to meet future load growth. The lowest cost new energy resource is assumed to be wind generation and the lowest cost capacity resource is a new gas turbine. The Pointe du Bois Renewable Energy Project defers future investments in these future energy and capacity resources.

The levelized cost of energy (LCOE) for this project is \$45/MWh (P80) and compares favorably with other alternatives for energy:

Alternative	LOCE (\$/MWh)
Wind	56
Solar	70
Notigi Generating Station (Hydro)	90
Conawapa Generating Station (Hydro)	92
Combined Cycle Gas Turbine	107
Simple Cycle Gas Turbine	177

REFERENCE DOCUMENTS

[DAD_PDB_GS_STUDY.docm](#)

[11676_CIC_AD_PDB_GS_SCOPE_DEVELOPMENT_1.docx](#)

Capital Investment Justification

REFERENCE DOCUMENTS

[11676 CIC AD PDB GS Life Assessment \(Shell\) 2.docx](#)

[11676 CIC AD Pointe du Bois 8 Unit Replacem 3.docx](#)

[Approved - REC-PdB Unit Replacement CIC-20220706.pdf](#)

[11676 CIC AD Pointe du Bois Renewable Energ 4.docx](#)

C55-CIC

**CAPITAL INVESTMENT CONCEPT
FOR**

System Control Centre Replacement – 820 Taylor Location

Investment Type (Project)

SCOPE DEVELOPMENT FUNDS:	\$544
CONCEPT ESTIMATE (incl. Scope Development):	\$55,548
CONTRIBUTIONS:	\$0
NET CONCEPT ESTIMATE (incl. Scope Development):	\$55,548
(values listed above are in thousands of dollars)	
CORPORATE VALUE FRAMEWORK SCORE :	Value: 44,323
	Value/\$K: 0.95

DATE PREPARED: 2019/06/10

EC/MHEB APPROVAL MINUTE & DATE:

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
Mailey, Shane	VP TRANSMISSION		VP Transmission	2019/06/11
Clark, Tony	DIRECTOR TRANSMISSION SYSTEMS OPERATIONS		Director - Trans System Operations	2019/06/11
Penner, Glenn	DIRECTOR TRANSMISSION CONST & LINE MTCE		Director - Trans Const & Line Mtc	2019/06/11
Adamkowicz, Mark	TRANSMISSION PROJECTS DEPARTMENT MGR		Transmission Project Management	2019/06/11
Petaski, Joe	SYSTEM SUPPORT DEPARTMENT MANAGER		System Support	2019/06/11
Long, Krista	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2019/06/10
Almeida, Andrea	PROJECT ENGINEER		Transmission Project Management	2019/06/10
Lee, Steven	STAFF OFFICER	On behalf Of Bell, Christine (cebell).	Transmission Project Management	2019/06/10

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Transmission	REQUESTING OPERATING/CORPORATE GROUP:	Transmission
RESPONSIBLE DIVISION:	Transmission Construction & Line Mtce	REQUESTING DIVISION:	Transmission System Operations
RESPONSIBLE DEPARTMENT:	Transmission Projects Department	ISD: (YYYY/MM/DD)	2019/08/30
I.M. NODE NUMBER:	2.1.30.15.05.18	W.B.S. NUMBERS:	P:32080
C55 INVESTMENT CODE:	22506		
SAP PROJECT TYPE:	21 - BOC-Manitoba Hydro Electric Board	C55 INVESTMENT SUB-CATEGORY:	Shell
CORPORATE INVESTMENT CATEGORIES:	(Level 1) C3 / Sustainment (Level 2) CM / System Renewal		

CONTACTS			
PREPARED BY:	Almeida, Andrea PROJECT ENGINEER 52710	REQUESTOR:	Joe Petaski, System Support
PROJECT MANAGER:	Almeida, Andrea PROJECT ENGINEER 52710		

MANITOBA HYDRO
CAPITAL INVESTMENT CONCEPT
System Control Centre Replacement – 820 Taylor Location

RECOMMENDATION

Develop a conceptual design and budget to replace the existing 820 Taylor System Control Centre which is at end of life.

SCOPE

Scope development activities, which would take place between June – October 2019 include:

1. A consultant to determine the scope of the replacement of the System Control Centre including square footage, electrical and mechanical requirements
2. A consultant to determine the feasibility of the following location options:
 - i. 100% inside the Riel converter building – available space and capacity of existing mechanical and electrical needs to be confirmed
 - ii. Combination of inside and expanding the Riel converter building by adding a 4th floor.
 - iii. Combination of inside the Riel converter building and building a standalone building within the Riel Station fence line.
 - iv. Building a standalone building within the Riel station fence line.
 - v. Building a standalone building on Manitoba Hydro owned property close to the Riel station.
3. Development of the detailed plan (scope, schedule, budget) and Capital Investment Justification (CIJ)

Overall project scope includes:

Design and construct building infrastructure for System Control Centre; and design, construct/procure and install critical building systems and fit out to meet control centre operational and compliance requirements.

BACKGROUND

Manitoba Hydro currently operates from System Control Centres located at 453 Dovercourt Drive and 820 Taylor Ave. System Control Centres are the central nervous system of the interconnected power systems (HVDC, Transmission, Generation, and Distribution) and are comprised of the control room, data centre, telecommunications assets and mechanical and electrical systems. It is both an operational and regulatory requirement that utilities have two viable and proven control centres operating concurrently.

The telecommunication assets enable system operators located within control rooms to control and monitor power system assets distributed throughout the province and are complex and highly interconnected arrangements of equipment and cabling, permitting the routing and cross connection of critical power system and administrative voice and data traffic.

Operational failure of these assets could result in Manitoba Hydro losing the ability to operate the power system

Capital Investment Concept

BACKGROUND

which could result in failure to avoid, contain, minimize, and recover from power system disturbances and worst case a province wide blackout.

Regulatory requirements call for System Control Centres to meet the North American Electric Reliability Corporation (NERC) Standards. NERC Standards identify requirements for planning, design, operation, maintenance and security of the North American bulk power system. These Standards are in place to help ensure the reliability of the North American bulk power system. NERC Standards are legally enforceable in Manitoba and are binding on the Corporation pursuant to the Manitoba Hydro Act. Demonstrating and testing the ability to operate from both control centres is required by NERC Standards.

The building at 820 Taylor and other systems critical to the function provided by the System Control Centre located within the building is putting power system operations at high risk. A 2013 condition assessment of 820 Taylor concluded that the building requires a major refurbishment of all major components, including mechanical, electrical and the building envelope. Many of these assets have not been replaced since the building's inception in the early 1960's and are being maintained well beyond asset life expectancy. The mechanical and electrical systems (power and cooling) are also beyond end of life. Mechanical and electrical risks include:

- Failure of cooling systems leading to equipment shutdown (cooling tower is single point of failure)
- Failure of electrical systems (switchgear, uninterruptable power supplies and generators)
- Internal flood risk due to end-of-life hydronic piping throughout 820 Taylor
- Electrical and mechanical replacement parts are no longer available
- Insufficient mechanical and electrical capacity required to meet load growth

The 820 Taylor 200,000 square foot building is primarily empty, leaving the System Control Centre as the sole tenant which requires approximately 30,000 square feet.

An evaluation has been completed comparing a number of potentially viable options for the location of the new System Control Centre including 3rd party hosting locations, retro-fit of 820 Taylor, other existing Manitoba Hydro locations as well as the construction of a new building. Considering cost and risk, installing the replacement system control centre in the Riel area was determined to be the preferred alternative.

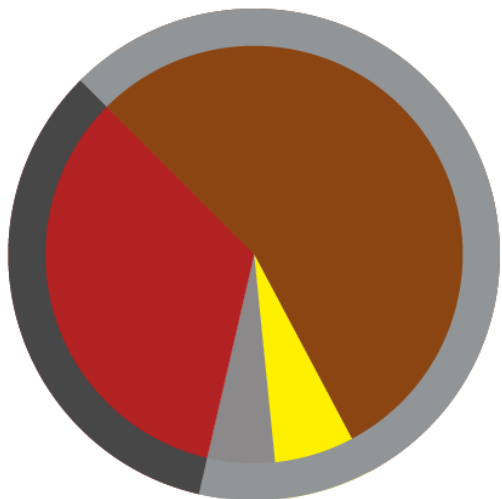
JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

JUSTIFICATION

A replacement for the 820 Taylor System Control Centre is required as the existing building and systems are beyond end of the life resulting in power system reliability risk and regulatory compliance (NERC Standards) risk.

Capital Investment Concept

CORPORATE VALUE FRAMEWORK



Value Measure	Value Points	% of Value
Technology Obsolescence Risk	75,239	54.74%
O&M Financial Benefits	8,471	6.16%
Compliance Risk	7,176	5.22%
Total Cost	-46,563	33.88%
Total Value	44,323	
Value/\$K	0.95	

Capital Investment Concept

OTHER ALTERNATIVES CONSIDERED

The following list of alternatives were considered:

- 3rd party hosting locations was dismissed as Manitoba Hydro does not relinquish full care and control of its critical assets crucial to bulk power system operations
- other Manitoba Hydro and non-Manitoba Hydro owned properties were deemed cost prohibitive

INVESTMENT RISK ANALYSIS

No identified risks.

ESTIMATED COST FLOW

The annual projected cost flows are as follows (in thousands of dollars):

Fiscal Year	Scope Development Funds	Concept Estimate Includes Scope Dev't	Total Estimated Investment (Net of Contrib.)
Prev. Actuals	\$0	\$0	\$0
2019/2020	\$544	\$919	\$919
2020/2021	\$0	\$375	\$375
2021/2022	\$0	\$32,127	\$32,127
2022/2023	\$0	\$22,127	\$22,127
2023/2024	\$0	\$0	\$0
2024/2025+	\$0	\$0	\$0
Total	\$544	\$55,548	\$55,548

Capital Investment Concept

IMPACT ON O&A COSTS

The full impact of the O&A costs will be determined at the CIJ stage considering:
-high maintenance costs currently at 820 Taylor until replacement control centre is constructed
-cancellation of Information Technology data centre lease costs - approximately \$600k/annum

RELATED INVESTMENTS

None

REFERENCE DOCUMENTS

C55-CIJ-PROJ

**CAPITAL INVESTMENT JUSTIFICATION
FOR**

System Control Centre Replacement – 820 Taylor Location

Investment Type (Project)

BUDGET:	\$46,937
CONTRIBUTIONS:	\$0
NET BUDGET:	\$46,937
(values listed above are in thousands of dollars)	
CORPORATE VALUE	Value: 57,128
FRAMEWORK SCORE:	Value/\$K: 1.44

DATE PREPARED: 2019/11/08

**EC/MHEB APPROVAL MINUTE &
DATE:**

November 19, 2019
Minute #:

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
Mailey, Shane	VP TRANSMISSION		VP Transmission	2019/11/08
Clark, Tony	DIRECTOR TRANSMISSION SYSTEMS OPERATIONS		Director - Trans System Operations	2019/11/08
Penner, Glenn	DIRECTOR TRANSMISSION CONST & LINE MTCE		Director - Trans Const & Line Mtc	2019/11/08
Neufeld, Maria	TRANSMISSION ASSET MANAGEMENT DEPT MGR		Transmission Asset Management	2019/11/08
Adamkowicz, Mark	TRANSMISSION PROJECTS DEPARTMENT MGR		Transmission Project Management	2019/11/08
Long, Krista	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2019/11/08
Almeida, Andrea	PROJECT ENGINEER		Transmission Project Management	2019/11/08
Bell, Christine	TRANS CAPITAL PORTFOLIO ACCOUNTANT		Transmission Project Management	2019/11/08

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Transmission	REQUESTING OPERATING/CORPORATE GROUP:	Transmission
RESPONSIBLE DIVISION:	Transmission Construction & Line Mtce	REQUESTING DIVISION:	Transmission System Operations
RESPONSIBLE DEPARTMENT:	Transmission Projects Department	ISD: (YYYY/MM/DD)	2022/12/20
I.M. NODE NUMBER:	2.1.30.15.05.18	W.B.S. NUMBERS:	P:32080, P:33143, P:33156
C55 INVESTMENT CODE:	22506		
SAP PROJECT TYPE:	22 - BOC-Executive Committee	C55 INVESTMENT SUB-CATEGORY:	Shell
CORPORATE INVESTMENT CATEGORIES:	(Level 1) C3 / Sustainment (Level 2) CM / System Renewal		

CONTACTS			
PREPARED BY:	Almeida, Andrea PROJECT ENGINEER 52710	REQUESTOR:	Tony Clark, Director Trans Systems Operations
PROJECT MANAGER:	Almeida, Andrea PROJECT ENGINEER 52710		

MANITOBA HYDRO
CAPITAL INVESTMENT JUSTIFICATION
System Control Centre Replacement – 820

RECOMMENDATION

Approve a budget of \$46.9 million to design and build a new System Control Centre within the Riel Station yard to replace the existing 820 Taylor System Control Centre which is at end of life.

SCOPE

Design and construct a new System Control Centre building within the Riel Converter Station including fit out of:

- Control Room;
 - Telecommunications & Data Centres;
 - Telecommunications Network Operations Centre;
 - Operational and Personnel Support Areas including training room, conference rooms, office space, kitchen, shower;
 - Mechanical Systems including redundant HVAC systems;
 - Electrical Systems including dual utility feeds, generators, Uninterruptable Power Supplies and batteries;
- and
- Parking

BACKGROUND

Manitoba Hydro currently operates from System Control Centres located at 453 Dovercourt Drive and 820 Taylor Ave. System Control Centres are the central nervous system of the interconnected power systems (HVDC, Transmission, Generation, and Distribution) and are comprised of the control room, data centre, telecommunications assets and mechanical and electrical systems. It is both an operational and regulatory requirement that utilities have two viable and proven control centres operating concurrently.

Operational failure of these assets could result in Manitoba Hydro losing the ability to operate the power system which could result in failure to avoid, contain, minimize, and recover from power system disturbances and worst case a province wide blackout.

Regulatory requirements call for System Control Centres to meet the North American Electric Reliability Corporation (NERC) Standards. NERC Standards identify requirements for planning, design, operation, maintenance and security of the North American bulk power system. These Standards are in place to help ensure the reliability of the North American bulk power system. NERC Standards are legally enforceable in Manitoba and are binding on the

Capital Investment Justification

BACKGROUND

Corporation pursuant to the Manitoba Hydro Act. Demonstrating and testing the ability to operate from both control centres is required by NERC Standards.

The building at 820 Taylor and other systems critical to the function provided by the System Control Centre located within the building is putting power system operations at high risk. A 2013 condition assessment of 820 Taylor concluded that the building requires a major refurbishment of all major components, including mechanical, electrical and the building envelope. Many of these assets have not been replaced since the building's inception in the early 1960's and are being maintained well beyond asset life expectancy. The mechanical and electrical systems (power and cooling) are also beyond end of life.

The 820 Taylor 200,000 square foot building is primarily empty, leaving the System Control Centre as the sole tenant which requires approximately 30,000 square feet.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

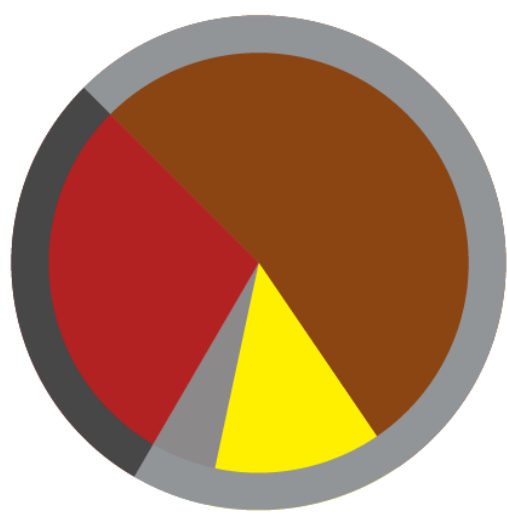
JUSTIFICATION

A replacement for the 820 Taylor System Control Centre is required as the existing building and systems are beyond end of life resulting in power system reliability and regulatory compliance (NERC Standards) risks. Manitoba Hydro is also preparing the office building to be declared surplus and sold.

During the scope development, a number of configuration options at the Riel location were evaluated using a consultant to determine feasibility, high-level cost and schedule. Considering cost and risk, constructing a freestanding building within the Riel station yard was determined to be the recommended alternative.

Capital Investment Justification

CORPORATE VALUE FRAMEWORK



Value Measure	Value Points	% of Value
Technology Obsolescence Risk	72,412	52.98%
O&M Financial Benefits	17,581	12.86%
Compliance Risk	6,905	5.05%
Total Cost	-39,770	29.1%
Total Value	57,128	
Value/\$K	1.44	

Capital Investment Justification

ANALYSIS OF ALTERNATIVES:

ECONOMIC ANALYSIS		
Discount Rate	For current corporate rates see P911 6%	

Active Option	NPV Benefits/(Costs)	CVF Score	Value/\$K
Preferred		57,128	1.44

Other Alternatives	NPV Benefits/(Costs)	CVF Score	Value/\$K

INVESTMENT RISK ANALYSIS

The construction contract budget and schedule is dependent on the market at the time of tendering. Consultation was done with a contractor and a third-party estimator as inputs into the CIJ.

A contingency of \$7.2 million has been included in the project.

ESTIMATED COST FLOW

The annual projected cost flows are as follows (in thousands of dollars):

Fiscal Year	Budget	Contributions	Net Budget
Prev. Actuals	\$0	\$0	\$0
2019/2020	\$662	\$0	\$662
2020/2021	\$6,011	\$0	\$6,011
2021/2022	\$29,309	\$0	\$29,309
2022/2023	\$10,920	\$0	\$10,920
2023/2024	\$35	\$0	\$35
2024/2025+	\$0	\$0	\$0
Total	\$46,937	\$0	\$46,937

Capital Investment Justification

IMPACT ON O&A COSTS

With the occupation of the new building at Riel and the disposal of the 820 Taylor office building it is expected that savings will be experienced with maintenance costs, decreased property taxes and security costs. These amounts have been incorporated with the Corporate Value Framework.

Pending a decision on the location strategy for the Information Technology Data Centres, O&A costs may decrease further.

PROPOSED SCHEDULE

2019 December – Design contract awarded
2020 April - Design contract completed
2020 August - Construction contract awarded
2022 August - Construction & commissioning contract completed
2022 December - System Control Centre in-service

RELATED INVESTMENTS

22506 CIC System Control Centre Replacement - 820 Taylor Location

OTHER ALTERNATIVES CONSIDERED

Other Manitoba Hydro owned properties were deemed cost prohibitive.
Retrofitting or expanding the existing Riel converter building was dismissed as these options were deemed cost prohibitive and had higher risk as well as being operationally impactful.

REFERENCE DOCUMENTS

[22506_CIC_System_Control_Centre_Replacem.docx](#)

C55-CIJ-PROJ

**CAPITAL INVESTMENT JUSTIFICATION
FOR**

Limestone Units 1-3, 5-10 Re-Wedge/Re-Shrink

Investment Type (Project)

BUDGET:	\$36,230
CONTRIBUTIONS:	\$0
NET BUDGET:	\$36,230
(values listed above are in thousands of dollars)	
CORPORATE VALUE	Value: 116,355
FRAMEWORK SCORE:	Value/\$K: 3.66

DATE PREPARED: 2019/05/17

**EC/MHEB APPROVAL MINUTE &
DATE:**

Approved by EC
August 13, 2019
Minute #:

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
Roy, Jillian	EXECUTIVE ASSISTANT	On behalf Of Midford, Lorne (lemidford).	VP Generation & Wholesale	2019/07/09
Turner, Hal	DIRECTOR GENERATION ASSET MANAGEMENT		Director - Generation Asset Management	2019/07/08
Kreml, John	DIRECTOR GENERATION OPERATIONS & MTCE		Director - Generation Ops & Maintenance	2019/07/08
Playford, Tom	NORTHERN GENERATION DEPARTMENT MANAGER		Lower Nelson River Operations	2019/06/25
Bishop, Gary	GEN ASSET STRATEGY & PERF DEPT MANAGER		Generation Asset Strategy and Performanc	2019/06/18
Miller, Sandy	GENERATION PROJECT MANAGEMENT DEPT MGR		Generation Project Management	2019/06/18
Orellana, Cristian	PROJECT MANAGEMENT SECTION HEAD		Generation Project Management	2019/06/18
Johnson, Erin	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2019/06/18
Edwards, Alaina	PROJECT CONTROL & REPORTING OFFICER		Generation Project Management	2019/05/21
Allard, Kathleen	PORTFOLIO PLANNER		Generation Asset Strategy and Performanc	2019/05/17

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Generation & Wholesale	REQUESTING OPERATING/CORPORATE GROUP:	Generation & Wholesale
RESPONSIBLE DIVISION:	Generation Asset Management	REQUESTING DIVISION:	Generation Operations and Maintenance
RESPONSIBLE DEPARTMENT:	Generation Project Management	ISD: (YYYY/MM/DD)	2023/11/30
I.M. NODE NUMBER:	2.1.20.15.02.64	W.B.S. NUMBERS:	P:32098
C55 INVESTMENT CODE:	22661		
SAP PROJECT TYPE:	22- BOC-Executive Committee	C55 INVESTMENT SUB-CATEGORY:	Single WBS
CORPORATE INVESTMENT CATEGORIES:	(Level 1) C3 / Sustainment (Level 2) CM / System Renewal		

CONTACTS			
PREPARED BY:	EDWARDS, ALAINA PROJECT CONTROL & REPORTING OFFICER 51460	REQUESTOR:	SYLVESTRE, JORDAN (jsylvestre)
PROJECT MANAGER:	FUGA, ADAM PROJECT ENGINEER 51460		

MANITOBA HYDRO
CAPITAL INVESTMENT JUSTIFICATION
Limestone Units 1-3, 5-10 Re-Wedge/Re-Shrink

RECOMMENDATION

Approve a budget of \$36.2M to complete re-wedge and re-shrink work on the generators of Units 1-3 and 5-10 to extend their useful life at Limestone Generating Station.

SCOPE

The scope of work includes:

- Replacement of the stator winding wedging system (re-wedge) on nine units;
- Inspection of rotor rim to spider shrink fit and refurbishment (re-shrink) on three units; and
- Generator component refurbishments as required based on the condition of the components during disassembly.

The scope of work excludes: spare stator bar supply, turbine/runner inspections or repairs, shaft seal filtration upgrades, or other work covered by the minor overhaul investments.

BACKGROUND

The Limestone units are original to the station and have been in service for approximately 28 years. While the condition indices of the stator are in generally good condition with scores of 7.7 - 8.0 out of 10, recent investigations have determined that the wedging system is in poor condition which can quickly deteriorate the overall condition.

Stator Winding Wedging System:

The stator winding wedging system is used to secure the stator windings inside the stator slots against radial movement caused by the electromagnetic forces exerted on the windings. Any movement of the winding in the slot will cause wear and cumulative deterioration of the windings, eventually leading to the failure of the winding. Testing performed by the Insulation Engineering & Testing Department has identified a high number of loose wedges in Limestone stators and recent deflection test measurements show the retainer style wedges are flat (95+%) indicating little to no force on bars which could lead to in-service failure.

Rotor Rim to Spider Shrink Fit:

The rotor rim is connected to the rotor spider using an interference fit (shrink fit). When the shrink fit is compromised, the rotor rim will be able to move in relation to the rotor spider, leading to potentially irreparable damage to the entire generator. Unit 4 was found to have lost its shrink fit and was re-shrunk in 2017 prior to incurring extensive damage. Recent inspections of other Limestone rotors revealed evidence of compromised shrink fit on three of seven units.

Capital Investment Justification

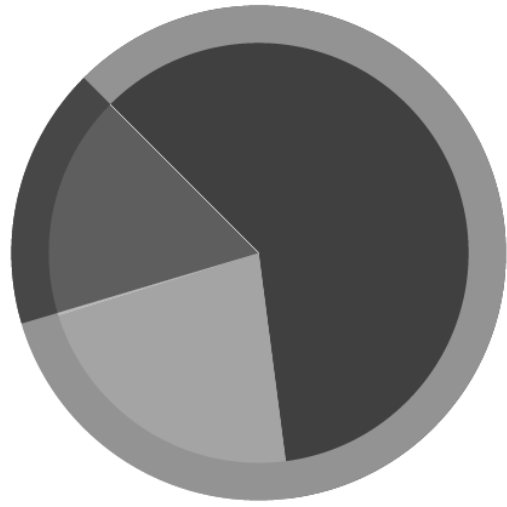
JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

JUSTIFICATION

This investment will mitigate the lost generation and financial risks associated with the potential failures of the generator and the consequential damage. Failure modes with unpredictable degradation trends like the stator wedging system and rotor rim shrink fit can often occur unexpectedly and result in consequences beyond repair and can result in very extensive forced outages ranging from months to years.

Capital Investment Justification

CORPORATE VALUE FRAMEWORK



Value Measure	Value Points	% of Value
Financial Risk	108,022	60.44%
Lost Generation Risk	39,769	22.25%
Environmental Risk	376	0.21%
Total Cost	-31,812	17.1%
Total Value	116,355	
Value/\$K	3.66	

Capital Investment Justification

ANALYSIS OF ALTERNATIVES:

ECONOMIC ANALYSIS		
Discount Rate	For current corporate rates see P911 6%	

Active Option	NPV Benefits/(Costs)	CVF Score	Value/\$K
Recommended		116,355	3.66

Other Alternatives	NPV Benefits/(Costs)	CVF Score	Value/\$K

INVESTMENT RISK ANALYSIS
<p>Scope:</p> <ul style="list-style-type: none"> There is a risk that scope will change during the project due to: new information being discovered during unit disassembly and inspection, unexpected changes in component condition, or development of corporate guidelines (for example: vibration and air gap monitoring). The scope change process will be used to manage and justify any new scope items. There is a risk that cracks may be discovered on the exterior of the rotor that require additional disassembly and work to refurbish, adding to project cost and outage length. No budget or schedule contingencies have been included for this work as inspections conducted to date have not shown evidence of cracks. Although, a budget of \$80K has been included for the design and manufacturing of support stands to mitigate outage schedule delays instead of waiting for these stands if cracking is found once the unit is disassembled. <p>Schedule:</p> <ul style="list-style-type: none"> There is a risk that scheduled in-service dates slip or unit orders change based on outage opportunities, water conditions, changes in scope, or other emergency repairs. This will be mitigated by detailing and scheduling outages as far in advance as possible. There is a risk that room availability in the Gillam area may be limited if other major projects in the Lower Nelson River area are executing at the same time. If contractors have to mobilize their own accommodations, there may be impacts to the schedule and budget. This will be mitigated by monitoring and coordinating with other projects, but overlap is possible. No budget contingency has been included. <p>Budget:</p> <ul style="list-style-type: none"> Major contracts have not been awarded. There is risk that the bids received do not align with the estimates generated. This has been mitigated by building estimates from recent work completed; however, market conditions and vendor lessons learned from previous work completed may result in unexpected bid prices. A contingency of \$150K per unit is included in the budget for this risk. There is a risk that the internal labour required to complete this work does not align with estimates due to learning curves or changes in staff. This will be monitored and updated as units are completed to predict the overall expected cost. The current budget includes funds for detailed assessments to verify shrink condition, and for a rotor rim to

Capital Investment Justification

INVESTMENT RISK ANALYSIS

spider shrink fit refurbishment on three of the nine units. There is a risk that the detailed inspection of the rotor rim-shrink condition does not align with the inspections completed to date and more or less re-shrinks are required. A contingency of \$1.25M has been included in the budget for re-shrinking an additional three units.

ESTIMATED COST FLOW

The annual projected cost flows are as follows (in thousands of dollars):

Fiscal Year	Budget	Contributions	Net Budget
Prev. Actuals	\$0	\$0	\$0
2019/2020	\$211	\$0	\$211
2020/2021	\$4,162	\$0	\$4,162
2021/2022	\$11,479	\$0	\$11,479
2022/2023	\$12,364	\$0	\$12,364
2023/2024	\$7,998	\$0	\$7,998
2024/2025+	\$17	\$0	\$17
Total	\$36,230	\$0	\$36,230

IMPACT ON O&A COSTS

No additional O&A costs have been identified as a result of this project.

PROPOSED SCHEDULE

- 2020/21 - Design, Procurement, Unit 7
- 2021/22 - Units 2, 3, 10
- 2022/23 - Units 1, 8, 9
- 2023/24 – Units 5, 6

RELATED INVESTMENTS

Limestone Unit 4 Stator Re-wedge and Rotor Rehabilitation CL#11157 P:26837

OTHER ALTERNATIVES CONSIDERED

Other alternatives that were considered:

- advancing a stator replacement
- advancing a stator rewind

The above noted alternatives would improve the reliability of the whole generator, but are more costly and not required at this time due to the general condition of the generator. Implementing these alternatives would also take significantly longer to complete, versus the recommended expedited re-wedge alternative, resulting in Manitoba Hydro carrying the risk of wedging failure for a longer period.

Capital Investment Justification

OTHER ALTERNATIVES CONSIDERED

There are no other viable solutions to restore the condition of the wedging system other than replacement.

REFERENCE DOCUMENTS

[Financial Chart P32098 LM Units ReWedge ReShrink.xlsx](#)

**MANITOBA HYDRO
POWER SUPPLY
DOMESTIC APPROVAL DOCUMENT**

<<R 01>>

PREV. APPROVED BUDGET \$: (Last Approved Domestic Approval Document)	-
REVISED BUDGET \$: (Total Net Cost)	\$58,950
START DATE: (1 st Cost Flow)	2014 04
PREV. APPROVED ISD: (In-service Date from last approved Domestic Approval Document)	
REVISED ISD: (Last Major In-service Date)	2014 08
PROJECT RANKING SCORE:	0.00
INVESTMENT REASON:	C3 / CAP - Sustainment

OWNING DIVISION: G12400 / Generation North

W.B.S. NUMBERS: P:23334

PROJECT OWNER MUZYCZKA, WALTER

DATE PREPARED: 2014 06 24

PROJECT CODE: 9305

JOBTRAC NUMBER: GEN0077

REFERENCE NUMBER:

Approver:	Approval Date:
Kreml, John (Division Manager)	2014 06 24
PAVLICIC, TONY	2014 06 10
MUZYCZKA, WALTER	2014 06 10
CHURCH, JEFF	2014 06 10
SHORT, JEFFERY	2014 05 22

Domestic Approval Document

Project: CRD CHURCHILL WEIR CULVERT STRUCTURE CONSULTATION

Recommendation

Procure consultant to perform condition assessment of existing structure and recommend repair alternatives.

Project Scope

Consultant to perform site investigation and inspection of existing structure and surrounding environment. From this investigation the consultant will prepare an inspection report outlining recommended alternatives for rehabilitation or reconstruction of fishway structure. Cost estimates for these alternatives will also be developed.

Background and Justification

Existing structure has been significantly damaged due to ice jamming and other factors, and is suspected to be structurally compromised. Churchill Weir maintenance work utilizes this structure to access the weir and is currently on hold until structure can be assessed and proposed recommendations for improvement are implemented.

Supports Generation North Goals of Safety and Reliability.

Risk of Proceeding

None

Other Alternatives Considered

Do nothing approach - not feasible as bridge condition is suspect and weir maintenance activities are on hold.

Domestic Approval Document

Project: CRD CHURCHILL WEIR CULVERT STRUCTURE CONSULTATION

CAPITAL BUDGET ESTIMATE:

Total Budget

The impact on annual budget requirements is as follows (in thousands of dollars):

Fiscal Year	Last Approved	Proposed	Increase (Decrease)
Prior Years		-	
2014/15		\$59	
2015/16		-	
2016/17		-	
2017/18		-	
2018/19 and on		-	
Total	-	\$59	\$59

Proposed Schedule

Consultant/MB Hydro site visit and condition assessment to take place as soon as climate conditions allow (June 2014).

MB Hydro to receive consultant report by July/August of 2014.

END OF CONSULTANT ASSIGNMENT

Post project schedule:

MB Hydro to choose preferred course of action after review of report. (August/September 2014)

MB hydro to initiate consultant design work (if required) and/or contractor procurement. (Fall of 2014)

Construct recommended alternative. (winter/spring/summer of 2015)

Related Projects

Churchill Weir annual maintenance

Reference Documents

The following documents support or provide background on this recommendation:

<<R 23-1.url>>

Report created by 'T37 - Generate Domestic Approval Document in Submitted SharePoint Folder' workflow task.

<<R 23-2.url>>

Domestic Approval Document
Project: CRD CHURCHILL WEIR CULVERT STRUCTURE CONSULTATION

Reference Documents

<<R 23-3.url>>

<<R 23-4.url>>

<<R 23-5.url>>

<<R 23-6.url>>

<<R 23-7.url>>

<<R 23-8.url>>

<<R 23-9.url>>

**MANITOBA HYDRO
POWER SUPPLY
DOMESTIC APPROVAL DOCUMENT**

<<R 01>>

Addendum Number: 1

PREV. APPROVED BUDGET \$: (Last Approved Domestic Approval Document)	\$58,950
REVISED BUDGET \$: (Total Net Cost)	\$336,235
START DATE: (1 st Cost Flow)	2014 04
PREV. APPROVED ISD: (In-service Date from last approved Domestic Approval Document)	2014 08
REVISED ISD: (Last Major In-service Date)	2016 11
PROJECT RANKING SCORE:	(240.83)
INVESTMENT REASON:	C3 / CAP - Sustainment

RESPONSIBLE DIVISION: G12700 / Engineering Services

W.B.S. NUMBERS: P:23334

PROJECT OWNER GONZALEZ, NINEL

DATE PREPARED: 2016 10 04

PROJECT CODE: 9305

JOBTRAC NUMBER: GEN0077

REFERENCE NUMBER:

Approver:	Approval Date:
WORTLEY, JOEL (Division Manager)	2016 10 04
Kreml, John	2016 10 04
RATUSHNIAK, GARRY	2016 10 02
BISHOP, GARY	2016 09 16
GONZALEZ, NINEL	2016 09 15
TURNER, HAL	2016 09 15
KARAGIANNIS, ALEXANDER	2016 09 15
BUUS, ERIK	2016 09 14
ALLARD, KATHLEEN	2016 09 14
PHILLIPS, BECKY	2016 09 13

Domestic Approval Document
Project: PRE-CONST CRD GOOSE CREEK FISHWAY CROSSING

Recommendation

Approve additional Preliminary Engineering budget to add assessment of the fish passage way through Goose Creek Crossing located on road CR20 to determine crossing requirements and additional review of crossing alternatives. This will include additional costs for internal resources to conduct a hydraulic study of Goose Creek catchment area.

Project Scope

Scope of the pre-construction work will include the completion of Concept Design Report "CDR" including detailed estimate of scope, budget, schedule and project evaluation "CVF" of alternatives and project approval justification documentation "CPJ".

Revised Estimate:

MH Internal \$168k

Travel & Accommodations \$28k

Consulting \$129k

Interest \$11k

Spring 2016 approval was granted via e-mail to proceed with a Bathometric Survey of both upstream and downstream of Goose Creek area at a cost of \$58k. This requirement was necessary and expedited due to internal resources availability and weather factors.

There has been approximately \$90k in costs to the end of 2015/16 for a condition assessment of the bridge, \$30k for consulting and \$60k internal costs. The bridge was deemed unsafe and recommended re-construction.

Background and Justification

The Goose Creek Fishway Crossing Structure is located on CR20 road in Churchill, Manitoba. CR20 road is used to access the Churchill River Weir for inspections and maintenance. The Goose Creek crossing structure is a bridge that was designed and constructed to provide an additional location for fish to pass upstream through CR20 road into the Goose Creek enhancement area.

Over the past 16 years the structural components of the bridge have been damaged by water flows and ice. It has been determined that the structure must be removed/replaced because it is unsafe for use. Maintenance work is currently scaled down until the crossing is replaced.

This project has synergies and is being executed with another project involving CR30 road in Churchill that is being funded through Indigenous Relations Division.

Risk of Proceeding

There is a small risk that the preliminary project planning and concept design study will not reveal value to proceed with the project.

This is a small risk since the asset being assessed is currently unsafe and impassable.

Other Alternatives Considered

Alternatives will be developed and addressed within the Concept Design Report along with a recommended

Domestic Approval Document
Project: PRE-CONST CRD GOOSE CREEK FISHWAY CROSSING

Other Alternatives Considered
course of action.

Domestic Approval Document
Project: PRE-CONST CRD GOOSE CREEK FISHWAY CROSSING

CAPITAL BUDGET ESTIMATE:

Total Budget

The impact on annual budget requirements is as follows (in thousands of dollars):

Fiscal Year	Last Approved	Proposed	Increase (Decrease)
Prior Years		\$91	
2016/17		\$246	
2017/18		-	
2018/19		-	
2019/20		-	
2020/21 and on		-	
Total	\$59	\$336	\$277

Proposed Schedule

Bathometric Survey - June 2016

Consultant/MB Hydro site visit and conceptual design report (CDR) - August 2016 to October 2016

Related Projects

Churchill River Weir annual maintenance

Reference Documents

The following documents support or provide background on this recommendation:

<<R 23-1.url>>

Report created by 'T37 - Generate Domestic Approval Document in Submitted SharePoint Folder' workflow task.

<<R 23-2.url>>

Report created by 'T43 - Generate Domestic Approval Document in Approved SharePoint Folder' workflow task.

<<R 23-3.url>>

<<R 23-4.url>>

<<R 23-5.url>>

<<R 23-6.url>>

<<R 23-7.url>>

<<R 23-8.url>>

<<R 23-9.url>>

Domestic Approval Document
Project: PRE-CONST CRD GOOSE CREEK FISHWAY CROSSING

Reference Documents

<<R 23-10.url>>

C55-CIC-AD

**CAPITAL INVESTMENT CONCEPT ADDENDUM
FOR**

**Churchill Weir Rehabilitation
Investment Type (Project)
Addendum Number 2**

	<u>PREVIOUSLY APPROVED</u>	<u>REVISED</u>	<u>INCREASE / (DECREASE)</u>
SCOPE DEVELOPMENT:	\$336	\$1,113	\$777
CONCEPT ESTIMATE (incl. Scope Development):	\$336	\$5,453	\$5,117
CONTRIBUTIONS:	\$0	\$0	\$0
NET CONCEPT ESTIMATE (incl. Scope Development):	\$336	\$5,453	\$5,117
(values listed above are in thousands of dollars)			
CORPORATE VALUE FRAMEWORK SCORE :		Value: N/A	Value: 307,252
		Value/\$K: N/A	Value/\$K: 72.59

DATE PREPARED: 2019/01/16

EC/MHEB APPROVAL MINUTE &

DATE: CAMEC-January 22/19

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
MIDFORD, LORNE	VP GENERATION & WHOLESALE		VP Generation & Wholesale	2019/01/21
TURNER, HAL	DIRECTOR GENERATION ASSET MANAGEMENT		Director - Generation Asset Management	2019/01/18
TURNER, HAL	DIRECTOR GENERATION ASSET MANAGEMENT		Director - Generation Asset Management	2019/01/18
BISHOP, GARY	GEN ASSET STRATEGY & PERF DEPT MANAGER		Generation Asset Strategy and Performanc	2019/01/17
MILLER, SANDY	GENERATION PROJECT MANAGEMENT DEPT		Generation Project Management	2019/01/17
Johnson, Erin	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2019/01/17
EDWARDS, ALAINA	PROJECT CONTROL & REPORTING OFFICER		Generation Project Management	2019/01/16
ALLARD, KATHLEEN	ASSET INVESTMENT PLANNING SECTION HEAD		Generation Asset Strategy and Performanc	2019/01/16

ADDENDUM NUMBER	DATE	REVISION (Summary of change)

CAPITAL INVESTMENT MASTER DATA

RESPONSIBLE OPERATING/CORPORATE GROUP:	Generation & Wholesale	REQUESTING OPERATING/CORPORATE GROUP:	Generation & Wholesale
RESPONSIBLE DIVISION:	Generation Asset Management	REQUESTING DIVISION:	Generation Operations and Maintenance
RESPONSIBLE DEPARTMENT:	Generation Project Management	ISD: (YYYY/MM/DD)	2020/10/31
I.M. NODE NUMBER:	2.1.20.15.03.1	W.B.S. NUMBERS:	P:30667, P:23334
C55 INVESTMENT CODE:	10613		
SAP PROJECT TYPE:	23 - BOC-Corporate Asset Management Executive Committee	C55 INVESTMENT SUB-CATEGORY:	Shell
CORPORATE INVESTMENT CATEGORIZATION:	(Level 1) C3 / Sustainment (Level 2) CM / System Renewal		

CONTACTS

PREPARED BY:	KJARTANSON, DERRICK STAFF OFFICER 51460	REQUESTOR:	YERENIUK, VAL (vayereniuk)
PROJECT MANAGER:	JOYAL, COLIN PROJECT ENGINEER 51460		

MANITOBA HYDRO
CAPITAL INVESTMENT CONCEPT ADDENDUM
Churchill Weir Rehabilitation

RECOMMENDATION

Increase the scope development budget by \$777k to \$1.1M for further analysis to determine the feasibility of additional alternatives to rehabilitate the weir, weir fishway, Goose Creek fishway crossing (including the fishway and enhancement reach) and east dyke.

SCOPE

Additional Scope:

- Hydraulic and salinity modeling (2D) to assess if water conditions are favourable for fish movements with different possible locations of the fish passage and realignment of the east dyke; and
- Preparation of a summary report outlining results of the hydraulic and salinity modeling (2D).

If the results of the 2D modeling do not provide sufficient information to determine the feasibility of the alternatives, additional 3D hydraulic and salinity modeling and summary reports may be required. \$335k has been included in the budget for this work.

Original scope development items:

- Preparation of scope development report(s) for the rehabilitation of the Goose Creek fishway crossing on the east dyke.
- Preparation of a project plan including detailed estimate of scope, budget and schedule for each alternative;
- Detailed investment evaluation within the Corporate Value Framework of all feasible alternative solutions; and
- Completion of the Capital Investment Justification (CIJ).

BACKGROUND

Budget Increase:

The initial CIC was started in 2015 to investigate alternatives for the rehabilitation of the Goose Creek fishway crossing portion of the weir which sustained damage in 2013. A concept design report was completed in March 2017 with a recommendation to construct a new bridge. Before work could be executed to replace the Goose Creek bridge, significant flooding occurred in May 2017 causing additional damage to the weir, weir fishway and east dyke. Sunk costs from the initial phase are being carried forward under this CIC addendum.

The Generation & Wholesale Advisory Committee has endorsed the expansion of the scope to include all the Churchill Weir assets including the weir, weir fishway, Goose Creek crossing (including the fishway and enhancement reach) and the east dyke.

Alternative configurations of the weir, weir fish passage and east dyke realignment have been identified which require additional studies to confirm their feasibility.

Weir:

A review of the impacts of the weir configuration alterations on maintenance construction logistics, regulatory requirements, and hydraulic performance is required to confirm the viability of the alterations as well as the

Capital Investment Concept Addendum

BACKGROUND

potential to reduce ongoing maintenance costs.

Weir Fishway:

Water is currently passing through one of the weir breaches at the west side of the weir. Additional studies will review the configuration of the weir and evaluate the viability of allowing the west side breach to remain as the permanent fishway structure.

Salinity and hydraulic modeling will assess if it is feasible for fish to travel between the relocated west side weir fishway and Goose Creek (greater travel distance), and if it is feasible for fish to travel between the west side weir fishway and the proposed alteration to the mouth of Goose Creek as part of the east dyke realignment.

East Dyke:

Access to the weir via the east dyke section has been limited since the Goose Creek fishway crossing was deemed unsafe in 2013. A proposed new crossing was evaluated as part of the original scope development and will be updated along with consideration for the proposed rehabilitation of other weir components.

An alternative alignment for the east dyke is being reviewed. The alternative alignment would allow access to the east dyke/weir across the existing CR30 access road thus eliminating the requirement for a Goose Creek fishway crossing and potentially having a positive effect on fish stocks.

Historical Background:

Manitoba Hydro (MH) commenced construction of the Churchill River Diversion (CRD) in 1973 to enable a substantial diversion of Churchill River flows into the Nelson River for the purposes of generating electricity. Lower water levels resulted in reduced navigation on the Churchill River along with a reduction in fish populations. Consequently, traditional use, recreation opportunities and enjoyment of the river by the Town of Churchill (Town) residents declined.

The 1997 Adverse Effects Agreement (The Agreement) with the Town was put in place to mitigate reductions to potential recreation and tourist opportunities, as well as resource harvesting. The local mitigation works included in the agreement included the construction of a weir across the Churchill River and the enhancement of the Goose Creek fish habitat. Fish stocks in the area have not returned following construction of the weir.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

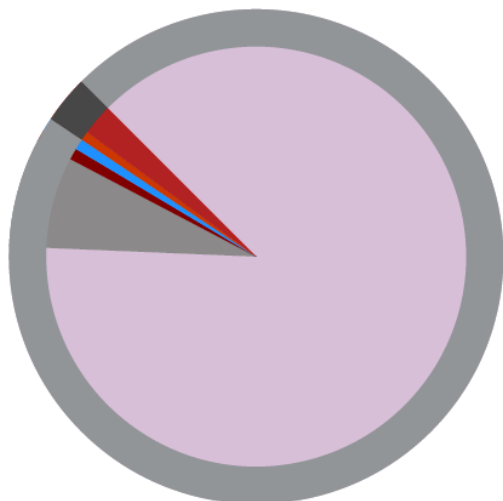
JUSTIFICATION

Manitoba Hydro is not currently in compliance with the 1997 Adverse Effects Agreement as the existing weir has been breached and is not able to retain water to the design rating curve.

Additional studies are required to validate the feasibility of reconfiguring the weir structure and support the revision of The Agreement to allow for the modifications. If feasible, the alternative configuration should result in lower construction and maintenance costs along with potential benefits to fish populations.

Capital Investment Concept Addendum

CORPORATE VALUE FRAMEWORK (REVISED)



Value Measure	Value Points	% of Value
Stakeholder Perception Risk	285,462	89.14%
Compliance Risk	22,727	7.1%
Financial Risk	2,855	0.89%
Safety Risk	2,704	0.84%
Environmental Risk	0	0%
O&M Costs	-2,264	0.71%
Total Cost	-4,233	1.32%
Total Value	307,252	
Value/\$K	72.59	

Capital Investment Concept Addendum

OTHER ALTERNATIVES CONSIDERED

Alternatives will be developed and addressed within the scope development phase. Combinations or separations of scope items will be reviewed during the corporate value framework evaluation process.

INVESTMENT RISK ANALYSIS

No additional investment risks have been identified as a result of this addendum.

MANITOBA HYDRO
CAPITAL INVESTMENT CONCEPT ADDENDUM
Churchill Weir Rehabilitation

ESTIMATED COST FLOW

The annual projected cost flows are as follows (in thousands of dollars):

	PREVIOUSLY APPROVED			PROPOSED			INCREASE/ (DECREASE)		
Fiscal Year	Scope Development Funds	Concept Estimate	Total Estimated Investment (Net of Contrib.)	Scope Development Funds	Concept Estimate	Total Estimated Investment (Net of Contrib.)	Scope Development Funds	Concept Estimate	Total Estimated Investment (Net of Contrib.)
Prev. Actuals	\$336	\$0	\$336	\$359	\$0	\$359	\$23	\$0	\$23
2018/2019	\$0	\$0	\$0	\$259	\$0	\$259	\$259	\$0	\$259
2019/2020	\$0	\$0	\$0	\$494	\$0	\$494	\$494	\$0	\$494
2020/2021	\$0	\$0	\$0	\$0	\$370	\$370	\$0	\$370	\$370
2021/2022	\$0	\$0	\$0	\$0	\$3,100	\$3,100	\$0	\$3,100	\$3,100
2022/2023	\$0	\$0	\$0	\$0	\$870	\$870	\$0	\$870	\$870
2023/2024+	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Total	\$336	\$0	\$336	\$1,113	\$4,340	\$5,453	\$777	\$4,340	\$5,117

IMPACT ON O&A COSTS

No additional O&A costs have been identified as a result of this addendum.

MANITOBA HYDRO
CAPITAL INVESTMENT CONCEPT ADDENDUM
Churchill Weir Rehabilitation

RELATED INVESTMENTS
None

REFERENCE DOCUMENTS
DAD PRE-CONST CRD GOOSE CREEK FISHWAY CROSSING 01.docm
DAD CRD CHURCHILL WEIR CULVERT STRUCTURE CONSULTATION.docm
2018 06 27 GWAC Meeting Minutes.docx
23334-Churchill Weir Pres to GW Advisory Committee-2018 06 27.pdf
23334-REC-Churchill weir study-2018 06 20.pdf
Financial Chart CRD Churchill Weir Rehab CIca2 December 2018.xlsx

C55-CIJ-PROJ

**CAPITAL INVESTMENT JUSTIFICATION
FOR**

Churchill River Diversion - Churchill Weir Rehabilitation

Investment Type (Project)

BUDGET:	\$10,263
CONTRIBUTIONS:	\$0
NET BUDGET:	\$10,263
(values listed above are in thousands of dollars)	
CORPORATE VALUE	Value: 357,151
FRAMEWORK SCORE:	Value/\$K: 44.32

DATE PREPARED: 2020-10-15

**EC/MHEB APPROVAL MINUTE &
DATE:**

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
Midford, Lorne	VP ASSET PLANNING & DELIVERY		VP Asset Planning & Delivery	2020-11-09
Turner, Hal	DIRECTOR ASSET MANAGEMENT		Director - Asset Management	2020-11-02
Bishop, Gary	GEN ASSET STRATEGY & PERF DEPT MANAGER		Generation Asset Strategy and Performanc	2020-10-28
Pawluk, James	GENERATION PROJECT MANAGEMENT DEPT MGR		Generation Project Management	2020-10-28
Austman, Jordan	PROJECT MANAGEMENT SECTION HEAD		Generation Project Management	2020-10-27
Johnson, Erin	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2020-10-27
Edwards, Alaina	PROJECT CONTROL & REPORTING OFFICER		Generation Project Management	2020-10-16
Allard, Kathleen	PORTFOLIO PLANNER		Generation Asset Strategy and Performanc	2020-10-15

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Asset Planning & Delivery	REQUESTING OPERATING/CORPORATE GROUP:	Generation & Wholesale
RESPONSIBLE DIVISION:	Asset Management	REQUESTING DIVISION:	Generation Operations and Maintenance
RESPONSIBLE DEPARTMENT:	Generation Project Management	ISD: (YYYY/MM/DD)	2024/10/31
I.M. NODE NUMBER:	2.1.20.15.03.1	W.B.S. NUMBERS:	P:30667, P:23334
C55 INVESTMENT CODE:	10613		
SAP PROJECT TYPE:	24 - BOC-VP & Management	C55 INVESTMENT SUB-CATEGORY:	Shell
CORPORATE INVESTMENT CATEGORIES:	(Level 1) C3 / Sustainment (Level 2) CM / System Renewal		

CONTACTS			
PREPARED BY:	Edwards, Alaina STAFF OFFICER 51460	REQUESTOR:	YERENIUK, VAL (vayereniuk)
PROJECT MANAGER:	Buus, Erik PROJECT OFFICER 51460		

MANITOBA HYDRO
CAPITAL INVESTMENT JUSTIFICATION
Churchill River Diversion - Churchill Weir Rehabilitation

RECOMMENDATION

Approve a budget of \$10.3M for the rehabilitation of the Churchill Weir.

SCOPE

This scope of this work includes:

- Rehabilitation of the weir to restore the original design rating curve
- Backfill the mainstem fishway and reshape the fishway at the new location to the west side of the weir
- Rehabilitation of damaged areas of the east dyke access to approximately CR20 access road
- Construction and removal of cofferdams required to rehabilitate the bridge and dyke breaches
- Construction of a new bridge crossing and fishway at Goose Creek
- Riffles downstream of the fish passage structure to promote fish movement
- Dredged a channel at the mouth of Goose Creek connecting it with the Churchill River
- Environmental approvals, fisheries compensation/mitigation, and stakeholder management

The scope does not include upgrades to CR20 access road, upgrades to CR30 access road or the boat landing on the west side of the Churchill River upstream of the Weir (part of the Public Safety Around Dams program).

BACKGROUND

Manitoba Hydro (MH) commenced construction of the Churchill River Diversion (CRD) in 1973 to enable a substantial diversion of Churchill River flows into the Nelson River for the purposes of generating electricity. Lower water levels resulted in reduced navigation on the Churchill River along with a reduction in fish populations. Consequently, traditional use, recreation opportunities, and enjoyment of the river by the Town of Churchill (Town) residents declined.

The 1997 Adverse Effects Agreement (The Agreement) with the Town was put in place to mitigate reductions to potential recreation and tourist opportunities, as well as resource harvesting. The local mitigation works included in the agreement included the construction of a weir across the Churchill River and the enhancement of the Goose Creek fish habitat.

The Weir consists of an overflow section, and two dyke sections. The overflow section originally featured a fishway segment at the lowest point of the Weir, but which has subsequently been filled in during maintenance. The east dyke incorporates the Goose Creek fishway and an emergency flood relief section. Fish habitat enhancements in the form of summer/winter ponds, and a riffle are included to promote spawning, feeding, and overwintering of Arctic Grayling in the Goose Creek area. Approval was granted through issuance of an Environmental Act (Manitoba) License, a Fisheries Act Authorization, and Navigable Waters Protection Act (NWPA) authorizations in 1998. The works were completed in 1999.

Although the Weir has performed adequately with respect to enhancing water levels and fish passage, fish stocks have not yet returned to pre-CRD levels.

The Weir, access dyke, fishway crossing, Goose Creek enhancement reach, CR30 access road, and other

Capital Investment Justification

BACKGROUND

infrastructure, suffer periodic damage from ice and flooding including in 2013 when it was deemed unpassable. Before work began to reconstruct the bridge, a record flow event occurred in May 2017 causing additional damage to the Weir, the weir fishway, and sections of the east access dyke.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

JUSTIFICATION

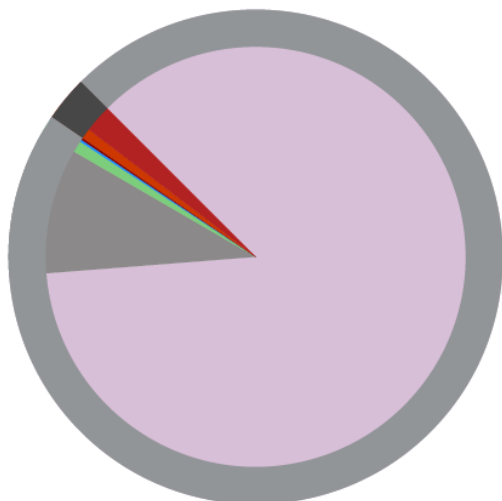
Stakeholder Perception Risk - Manitoba Hydro is not currently in compliance with The Agreement as the existing weir has been breached and is not able to retain water to the design rating curve. The weir is also part of the ongoing commitment to mitigate reductions to potential recreation and tourist opportunities, as well as resource harvesting.

Compliance Risk – the Weir in its current state is not compliant with federal fish regulations and the Provincial Environment Act. The naturally formed fish passage on the west side allows water and fish through but is contrary to the authorized fish passage mechanism and will require design, authorization, and monitoring. Rehabilitation is also required to restore the weir's water level control ability.

Environmental - The current design of the weir, east dyke and goose creek bridge, although authorized under the licence, have had an impact on fish and nesting bird habitat. Rehabilitation, improved maintenance and operating practices along with monitoring are required to evaluate/demonstrate if the original design assumptions on the fish diversity and population can be achieved.

Capital Investment Justification

CORPORATE VALUE FRAMEWORK



Value Measure	Value Points	% of Value
Stakeholder Perception Risk	327,082	86.26%
Compliance Risk	36,420	9.6%
Environmental Risk	3,364	0.89%
Safety Risk	696	0.18%
Financial Risk	602	0.16%
O&M Costs	-2,955	0.78%
Total Cost	-8,058	2.13%
Total Value	357,151	
Value/\$K	44.32	

Capital Investment Justification

ANALYSIS OF ALTERNATIVES:

ECONOMIC ANALYSIS		
Discount Rate	For current corporate rates see P911 6.5%	

Active Option	NPV Benefits/(Costs)	CVF Score	Value/\$K
Replacement in kind		357,151	44.23

Other Alternatives	NPV Benefits/(Costs)	CVF Score	Value/\$K
Realignment of dykes and remove bridge		315,598	20.04

INVESTMENT RISK ANALYSIS

The relocation of the mainstem fishway to the west side of the weir will have to go through the Fisheries Act Amendment process including section 35 consultation. Contingency has been included to address uncertainties relating to fisheries adaptive management requirements for the weir configuration.

There is a risk that an extreme event such as flooding could cause damage to the structure requiring further remediation and expanded scope.

The schedule assumes that the channel will freeze solid in winter to allow dredging from the ice. There is a risk that this is not feasible, and the work would have to be done as in-water work resulting in additional timing restrictions and environmental protection measures, likely extending the schedule and increasing costs.

ESTIMATED COST FLOW

The annual projected cost flows are as follows (in thousands of dollars):

Fiscal Year	Budget	Contributions	Net Budget
Prev. Actuals	\$690	\$0	\$690
2020/2021	\$298	\$0	\$298
2021/2022	\$830	\$0	\$830
2022/2023	\$2,135	\$0	\$2,135
2023/2024	\$4,926	\$0	\$4,926
2024/2025	\$1,383	\$0	\$1,383
2025/2026+	\$0	\$0	\$0
Total	\$10,263	\$0	\$10,263

Capital Investment Justification

IMPACT ON O&A COSTS

Manitoba Hydro will be responsible for supporting the maintenance of the weir including annual maintenance and inspections in line with the Canadian Dam Safety Guidelines and regular bridge and road repair in line with Structural Design Specifications. It is anticipated that this will come at an average annual cost of approximately \$150K over the remaining life of the asset.

PROPOSED SCHEDULE

Final Design and project description - Oct 2020 to March 2021
Environmental Approvals - April 2021 to March 2022
Procurement – April 2022 to Sept 2022
Construction – October 2022 to December 2024

RELATED INVESTMENTS

N/A

OTHER ALTERNATIVES CONSIDERED

Realignment of the dyke was considered during the scope development phase but has a significantly higher cost and carries additional risk related to renegotiating The Agreement, application for a new Fisheries Act Authorization, and potential fisheries adaptive management measures.

REFERENCE DOCUMENTS

[DAD_PRE-CONST CRD GOOSE CREEK FISHWAY CROSSING 01.docm](#)
[DAD_CRD CHURCHILL WEIR CULVERT STRUCTURE CONSULTATION.docm](#)
[Financial Chart CRD Churchill Weir Rehab CIGa2 December 2018.xlsx](#)
[10613_CIG AD_CRD Churchill Weir Rehabilitat 1.docx](#)
[CRD Churchill Weir Financial Chart CIJ Oct 2020.xlsx](#)

C55-CIJ-PROJ-AD

**CAPITAL INVESTMENT JUSTIFICATION ADDENDUM
FOR**

**Churchill Weir Rehabilitation
Investment Type (Project)
Addendum Number 1**

	<u>PREVIOUSLY APPROVED</u>	<u>REVISED</u>	<u>INCREASE/ (DECREASE)</u>
BUDGET:	\$10,263	\$29,416	\$19,153
CONTRIBUTIONS:	\$0	\$0	\$0
NET BUDGET:	\$10,263	\$29,416	\$19,153
(values listed above are in thousands of dollars)			
CORPORATE VALUE	Value: 357,128	Value: 337,543	
FRAMEWORK SCORE:	Value/\$K: 44.19	Value/\$K: N/A	

Approved by Jay Grewal,
President & CEO on November
14, 2022

**EC/MHEB APPROVAL MINUTE &
DATE:**

DATE PREPARED: 2022-09-16

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
Turner, Hal	VP ASSET PLANNING & DELIVERY		VP Asset Planning & Delivery	2022-11-10
Pawluk, James	DIRECTOR ASSET MANAGEMENT		Director - Asset Management	2022-10-11
Halayko, Krista	ASSET MGMT STRATEGY & PLANNING DEPT MGR		Asset Management Strategy & Planning	2022-09-26
Orellana, Cristian	GENERATION PROJECTS DEPARTMENT MANAGER		Generation Projects	2022-09-26
Johnson, Erin	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2022-09-23
Swait, Caitlin	FINANCIAL SERVICES LEAD - GEN PROJECTS		Project Services	2022-09-22
Dlot, Aaron	ASSET INVESTMENT PLANNING SECTION HEAD		Asset Management Strategy & Planning	2022-09-16

ADDENDUM NUMBER	DATE	REVISION (Summary of change)
CIJ	2022-11-09	Approve a budget of \$10.3M for the rehabilitation of the Churchill Weir.

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Asset Planning & Delivery	REQUESTING OPERATING/CORPORATE GROUP:	Asset Planning & Delivery
RESPONSIBLE DIVISION:	Project Management	REQUESTING DIVISION:	Asset Management
RESPONSIBLE DEPARTMENT:	Generation Projects	ISD: (YYYY/MM/DD)	2024/09/30
I.M. NODE NUMBER:	2.1.20.15.03.1	W.B.S. NUMBERS:	P:30667, P:23334
C55 INVESTMENT CODE:	10613		
SAP PROJECT TYPE:	22 - BOC-CEO	C55 INVESTMENT SUB-CATEGORY:	Shell
CORPORATE INVESTMENT CATEGORIZATION:	(Level 1) C3 / Sustainment (Level 2) CM / System Renewal		

CONTACTS			
PREPARED BY:	Swait, Caitlin FINANCIAL SERVICES LEAD - GENERATION PROJECTS 51185	REQUESTOR:	Ninel Gonzalez, Asset Lifecycle Management
PROJECT MANAGER:	Johnson, Rick PROJECT OFFICER 51460		

MANITOBA HYDRO
CAPITAL INVESTMENT JUSTIFICATION ADDENDUM
Churchill Weir Rehabilitation

RECOMMENDATION

Increase the budget by \$19.1M to \$29.4M from \$10.3M due to additional environmental mitigation measures, design changes during final design, changes in market pricing and an increase in contingency to mitigate identified execution risks.

SCOPE

The scope of the added work includes:

- Changes to the design from the conceptual design phase to the final design phase, specifically; the fishway, cofferdams, and Goose Creek Bridge, resulting in increased material quantities, and changes to the bridge design to improve resistance to ice damage
- Addition of aquatic and terrestrial mitigation measures
- Addition of rehabilitation of the existing “bird island”
- Extension of the construction schedule from two years to three years to mitigate risks related to compliance with environmental restrictions.

BACKGROUND

With the construction of the Churchill River Diversion (CRD) in 1973 to enable a substantial diversion of Churchill River flows into the Nelson River for the purposes of generating electricity. Lower water levels resulted in reduced navigation on the Churchill River along with a reduction in fish populations. Consequently, traditional use, recreation opportunities, and enjoyment of the river by the Town of Churchill (Town) residents declined.

The 1997 Adverse Effects Agreement (The Agreement) with the Town was put in place to mitigate reductions to potential recreation and tourist opportunities as well as resource harvesting. The local mitigation works in the agreement included the construction of a weir across the Churchill River and the enhancement of the Goose Creek fish habitat.

The weir, access dike, fishway crossing, Goose Creek enhancement reach, CR30 access road, and other infrastructure, suffered damage from ice and flooding in both 2013 and 2017.

The original CIJ and conceptual design had the construction to the damaged areas to be returned to the original design which was based on an outdated 1 in 100-year flood criteria. In order to meet the updated 1 in 100-year flood event design criteria, all of the structures’ elevations had to be raised which also includes widening the dikes and cofferdams at a cost of approximately \$10M. The Goose Creek Bridge was damaged shortly after original construction by ice damming, to prevent this from happen again the bridge was redesigned utilizing different material and raising the bottom of the bridge by 1.6 meter for an estimated cost of \$2M.

An island south of the weir, known as “Bird Island” was part of the original construction of the weir. The Island is used as a nesting ground and was constructed to compensate for bird nesting habitat lost due to the project construction. The island is in need of repair and is required as part of the strategy to deter birds from nesting on the weir during construction. Rehabilitation of bird island will increase cost by \$300K while the addition of aquatic and terrestrial mitigation measures is estimated at \$1.3M.

Capital Investment Justification Addendum

BACKGROUND

Stage 1 of construction consists of material production, east dike repairs, west side weir rehabilitation and installation of the rock groin at the Goose Creek fishway crossing and was awarded in July 2022. Stage 2 consists of construction of the new crossing at Goose Creek, repairs to the east dike breaches within the cofferdam, and rehabilitation of the Goose Creek fishway. The project estimate, including the remaining construction (stage 1 and 2), has been updated based on market pricing from the recently awarded stage 1 contract, the revised project scope and contingency review. Extension of the construction schedule adds approximately \$3M to the cost of the investment.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

JUSTIFICATION

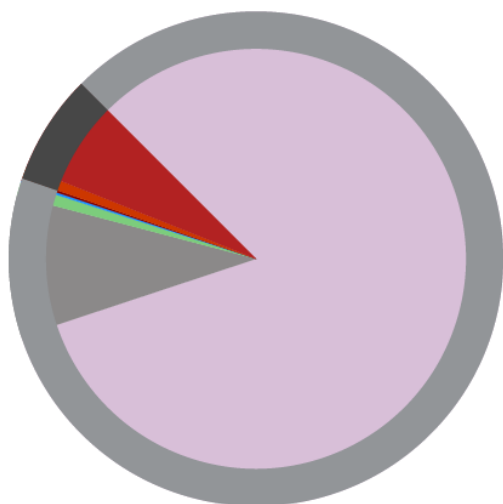
Stakeholder Perception Risk - Manitoba Hydro is not currently in compliance with The Agreement as the existing weir has been breached and is not able to retain water to the design rating curve. The weir is also part of the ongoing commitment to mitigate reductions to potential recreation and tourist opportunities, as well as resource harvesting.

Compliance Risk – the weir in its current state is not compliant with federal fish regulations and the provincial Environment Act. The naturally formed fish passage on the west side allows water and fish through but is contrary to the authorized fish passage mechanism and will require design, authorization, and monitoring. Rehabilitation is also required to restore the weir’s water level control ability.

Environmental Risk - The current design of the weir, east dyke and Goose Creek bridge, although authorized under the licence, have had an impact on fish and nesting bird habitat. Rehabilitation, improved maintenance and operating practices along with monitoring are required to evaluate/demonstrate if the original design assumptions on the fish diversity and population can be achieved.

Capital Investment Justification Addendum

CORPORATE VALUE FRAMEWORK (REVISED)



Value Measure	Value Points	% of Value
Stakeholder Perception Risk	325,163	82.42%
Compliance Risk	36,206	9.18%
Environmental Risk	3,344	0.85%
Safety Risk	692	0.18%
Financial Risk	637	0.16%
O&M Costs	-3,028	0.77%
Total Cost	-25,471	6.46%
Total Value	337,543	
Value/\$K	N/A	

Capital Investment Justification Addendum

ANALYSIS OF ALTERNATIVES:

ECONOMIC ANALYSIS		
Discount Rate	For current corporate rates see P911 6%	

Active Option	NPV Benefits/(Costs)	CVF Score	Value/\$K
Active		337,543	N/A

INVESTMENT RISK ANALYSIS
<p>A total contingency of \$4.14M has been requested to complete this project, an increase of \$2.6M from the previously approved amount. Project contingency covers known risks including but not limited to:</p> <ol style="list-style-type: none"> 1) High water levels/ flooding - \$1.3M 2) Market value, bids greater than expected - \$1.1M 3) Material availability - \$437K 4) Transportation to site - \$326K

MANITOBA HYDRO
CAPITAL INVESTMENT JUSTIFICATION ADDENDUM
Churchill Weir Rehabilitation

ESTIMATED COST FLOW

The annual projected cost flows are as follows (in thousands of dollars):

	PREVIOUSLY APPROVED			PROPOSED			INCREASE / (DECREASE)		
Fiscal Year	Budget	Contributions	Net Budget	Budget	Contributions	Net Budget	Budget	Contributions	Net Budget
Prev. Actuals	\$1,818	\$0	\$1,818	\$1,499	\$0	\$1,499	(\$319)	\$0	(\$319)
2022/2023	\$2,135	\$0	\$2,135	\$10,007	\$0	\$10,007	\$7,872	\$0	\$7,872
2023/2024	\$4,926	\$0	\$4,926	\$6,431	\$0	\$6,431	\$1,504	\$0	\$1,504
2024/2025	\$1,383	\$0	\$1,383	\$11,454	\$0	\$11,454	\$10,071	\$0	\$10,071
2025/2026	\$0	\$0	\$0	\$25	\$0	\$25	\$25	\$0	\$25
2026/2027	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2027/2028+	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Total	\$10,263	\$0	\$10,263	\$29,416	\$0	\$29,416	\$19,153	\$0	\$19,153

IMPACT ON O&A COSTS

Manitoba Hydro will be responsible for supporting the maintenance of the weir including annual maintenance and inspections, identified in the maintenance plan.

Post-construction monitoring of fish populations and fish passage systems is required as part of the Fisheries approval for the project. Adaptive management measures related to the west side fishway relocation and Goose Creek fishway may be identified from the post-construction monitoring.

It is anticipated that this will come at an average annual cost of approximately \$150K over the remaining life of the asset.

MANITOBA HYDRO
CAPITAL INVESTMENT JUSTIFICATION ADDENDUM
Churchill Weir Rehabilitation

PROPOSED SCHEDULE

Final Design and project description - October 2020 to October 2022
Environmental approvals - April 2021 to September 2022
Procurement – January 2022 to June 2023
Construction – July 2022 to December 2024

RELATED INVESTMENTS

N/A

OTHER ALTERNATIVES CONSIDERED

N/A

REFERENCE DOCUMENTS

[10613_CIC_AD_CRD Churchill Weir Rehabilitat_1.docx](#)

[10613_CIJ_CRD Churchill Weir Rehabilitat.docx](#)

C55-CIC

**CAPITAL INVESTMENT CONCEPT
FOR**

GR Unit 1 Turbine Runner Rehab

Project Category (Project)

SCOPE DEVELOPMENT FUNDS:	\$254
CONCEPT ESTIMATE (incl. Scope Development):	\$11,205
CONTRIBUTIONS:	\$0
NET CONCEPT ESTIMATE (incl. Scope Development):	\$11,205
(values listed above are in thousands of dollars)	
CORPORATE VALUE	Value: 118,178
FRAMEWORK SCORE :	Value/\$K: 14.64

DATE PREPARED:

2017/07/10

**EC/MHEB APPROVAL MINUTE &
DATE:**

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
TURNER, HAL	DIRECTOR GENERATION ASSET MANAGEMENT		Director - Generation Asset Management	2017/07/28
BISHOP, GARY	GEN ASSET STRATEGY & PERF DEPT MANAGER		Generation Asset Strategy and Performanc	2017/07/28
PENNER, KEVIN	MECHANICAL SECTION HEAD		Generation Maintenance and Oper Support	2017/07/28
BORTOLUZZI, LINDSEY	PROFESSIONAL ACCOUNTANT		Mgmt Financial Svcs - Corp. & Trans.	2017/07/26
ALLARD, KATHLEEN	ASSET INVESTMENT PLANNING SECTION HEAD	On behalf Of HARBER, KRISTINA (krharber). Approved on behave of K. Harber as initiator.	Generation Asset Strategy and Performanc	2017/07/10
ALLARD, KATHLEEN	ASSET INVESTMENT PLANNING SECTION HEAD		Generation Asset Strategy and Performanc	2017/07/10

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE BUSINESS UNIT:	Generation & Wholesale	REQUESTING BUSINESS UNIT:	Generation & Wholesale
RESPONSIBLE DIVISION:	Engineering Services	REQUESTING DIVISION:	Generation South
RESPONSIBLE DEPARTMENT:	Power Projects		
I.M. NODE NUMBER:	2.1.20.15.02.68	W.B.S. NUMBERS:	P:28740
C55 PROJECT CODE:	4581		
SAP PROJECT TYPE:	24 - BOC-VP & Management	C55 PROJECT SUB-CATEGORY:	Default
CORPORATE INVESTMENT CATEGORIES:	(Level 1) CP / Capital (Level 2) C3 / CAP - Sustainment		

CONTACTS			
PREPARED BY:	HARBER, KRISTINA CAPITAL PLANNING ANALYST 51455	REQUESTOR:	Kevin Penner
PROJECT MANAGER:	MILLER, SANDY GENERATION PROJECT MANAGEMENT DEPT MGR 51460		

MANITOBA HYDRO
CAPITAL INVESTMENT CONCEPT
GR Unit 1 Turbine Runner Rehab

RECOMMENDATION

Approve funding for the scope development phase for a major overhaul of the Grand Rapids G.S. Unit 1 turbine runners.

SCOPE

The scope development phase will include:

Preparation of a Concept Design Report

Preparation of a Project Plan including detailed estimate of scope, budget and schedule for each alternative, project risk mitigation and stakeholder engagement plan

Detailed investment evaluation within the Corporate Value Framework of all feasible alternative solutions

Preparation of the Capital Investment Justification (CIJ)

BACKGROUND

The Grand Rapids Unit 1 runner requires rehabilitation to repair wearing blade trunnion bushings which lead to excessive water leakage into the runner and governor system and could also lead to oil release into the Saskatchewan River. The runner must be removed from the unit to perform this work. The remaining scope consists of opportunity items. The initial identified investment alternative will not increase the capacity or efficiency of Unit 1.

The main value provided by this project is to improve runner blade trunnion seal performance and longevity. The runner itself is still functioning well.

The Kaplan turbines at Grand Rapids are expected to have a shorter lifespan between overhauls compared to a propeller turbine typical of the majority of the fleet. This is due to the significantly greater mechanical complexity of these machines and their tendency to be used for continuous capacity adjustments to the grid. (That is, these units are constantly cycling rather than being run at a single output).

Condition Score of turbine:

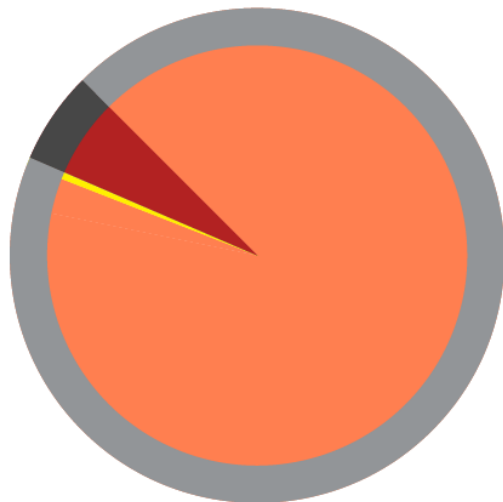
Unit 1 – Poor assessed at 1.4/10

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

JUSTIFICATION

The Grand Rapids Unit 1 turbine runner internal mechanism is wearing due to age and requires rehabilitation to mitigate the risk of oil leakage into the Saskatchewan River and significant O&M costs to frequently replace the blade trunnion seals. These issues are significantly reducing the reliability and availability of this generating unit. The only practical way to mitigate these risks is to remove the runner from the unit and rehabilitate the runner hub internals.

CORPORATE VALUE FRAMEWORK



Value Measure	Value Points	% of Value
Lost Generation Risk Auto	121,847	90.71%
Lost Generation Risk	3,662	2.73%
O&M Financial	659	0.49%
O&M Financial	69	0.05%
Environmental Risk	12	0.01%
Total Cost	-8,071	6.01%
Total Value	118,178	
Value/\$K	14.64	

Capital Investment Concept

OTHER ALTERNATIVES CONSIDERED

There have been no other alternatives identified during the preliminary CVF evaluation. Further alternatives will be explored in the scope development phase.

PROJECT RISK ANALYSIS

There is a small risk that the value of all alternatives identified will diminish with further evaluation and as scope is developed such that it will no longer be recommended to proceed with this capital investment and all sunk cost will need to be expensed.

ESTIMATED COST FLOW

The annual projected cost flows are as follows (in thousands of dollars):

Fiscal Year	Scope Development Funds	Concept Estimate (Net of Contrib.)	Total Estimated Investment
Prev. Actuals	\$0	\$0	\$0
2018/2019	\$254	\$256	\$256
2019/2020	\$0	\$12	\$12
2020/2021	\$0	\$324	\$324
2021/2022	\$0	\$444	\$444
2022/2023	\$0	\$8,368	\$8,368
2023/2024+	\$0	\$1,800	\$1,800
Total	\$254	\$11,205	\$11,205

Final Inservice Date – March 2024

Capital Investment Concept

IMPACT ON O&A COSTS	

RELATED INVESTMENTS
N/A

REFERENCE DOCUMENTS

C55-CIJ-PROJ

**CAPITAL INVESTMENT JUSTIFICATION
FOR**

Grand Rapids Unit 1 Turbine Runner Rehabilitation

Investment Type (Project)

BUDGET:	\$19,807
CONTRIBUTIONS:	\$0
NET BUDGET:	\$19,807
(values listed above are in thousands of dollars)	
CORPORATE VALUE	Value: 81,347
FRAMEWORK SCORE:	Value/\$K: 6.04

DATE PREPARED: 2022-05-20

EC/MHEB APPROVAL MINUTE & DATE: Approved by Aurel Tess, CFO
on July 13, 2022

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
Turner, Hal	VP ASSET PLANNING & DELIVERY		VP Asset Planning & Delivery	2022-07-13
Pawluk, James	DIRECTOR ASSET MANAGEMENT		Director - Asset Management	2022-07-07
Bowen, Dave	DIRECTOR PROJECT MANAGEMENT		Director Project Management	2022-07-05
Halayko, Krista	ASSET MGMT STRATEGY & PLANNING DEPT MGR		Asset Management Strategy & Planning	2022-06-30
Orellana, Cristian	GENERATION PROJECTS DEPARTMENT MANAGER		Generation Projects	2022-06-29
Johnson, Erin	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2022-06-27
Swait, Caitlin	FINANCIAL SERVICES LEAD - GEN PROJECTS		Project Services	2022-05-20
Dlot, Aaron	ASSET INVESTMENT PLANNING SECTION HEAD		Asset Management Strategy & Planning	2022-05-20

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Asset Planning & Delivery	REQUESTING OPERATING/CORPORATE GROUP:	Generation & Wholesale
RESPONSIBLE DIVISION:	Asset Management	REQUESTING DIVISION:	Generation Operations and Maintenance
RESPONSIBLE DEPARTMENT:	Asset Management Strategy & Planning	ISD: (YYYY/MM/DD)	2028/03/31
I.M. NODE NUMBER:	2.1.20.15.02.68	W.B.S. NUMBERs:	P:28740, P:30675
C55 INVESTMENT CODE:	4581		
SAP PROJECT TYPE:	24 - BOC-VP & Management	C55 INVESTMENT SUB-CATEGORY:	Shell
CORPORATE INVESTMENT CATEGORIES:	(Level 1) C3 / Sustainment (Level 2) CM / System Renewal		

CONTACTS			
PREPARED BY:	Swait, Caitlin FINANCIAL SERVICES LEAD - GEN PROJECTS 51185	REQUESTOR:	Kevin Penner
PROJECT MANAGER:	Maloney, Rick PROJECT OFFICER 51460		

MANITOBA HYDRO
CAPITAL INVESTMENT JUSTIFICATION
Grand Rapids Unit 1 Turbine Runner Rehabilitation

RECOMMENDATION

Approve a budget of \$19.8 million for the replacement of the Grand Rapids Unit 1 turbine runner and refurbishment of the rotor, stator and other related mechanical and electrical auxiliary equipment to extend its useful life.

SCOPE

The scope of work includes:

- Turbine – Design, procurement and replacement of a new turbine runner made with stainless steel blades; perform cavitation repairs and anchoring on turbine embedments as required; and inspect and refurbish other turbine components.
- Generator – Reinsulate and clean rotor poles; re-wedge and clean stator; replace surface air coolers; and inspect and refurbish any other damaged generator components.
- Electrical Auxiliary – Install vibration and air gap probes, replace existing fire system detection and deluge release.
- Intake Gates – Replace gate seals, rollers and coating as required

The scope of work excludes work to the exciter, governor and protection, unit control and monitoring system (UCMS), and generator step-up (GSU) transformers.

BACKGROUND

The Grand Rapids Unit 1 runner was replaced in 1995 by Alstom and is a Kaplan design which allows the unit to run over a broader power band. Compared to a propeller turbine, Kaplan turbines have significant greater mechanical complexity and typically experience a shorter lifespan between overhauls due to wear & tear on the runner bushings and seals and the blades' operating mechanism. These turbines are also typically used for continuous capacity adjustments to the grid (Automatic Generator Control Mode) in which they are constantly cycling rather than being run at a single output. Although there has been no indication of cracking to date, Kaplan blades are prone to fatigue cracking as they near their end of life which is typically 40 years.

The Grand Rapids Unit 1 runner requires attention to address wearing blade trunnion bushings and hub sealing surfaces which are showing signs of failure. These failures can lead to excessive water leakage into the runner hub and/or governor system and could also lead to oil release into the Saskatchewan River. Also because the existing runner blades will be ~ 30 years old when the project is in execution, fatigue cracking of the runner blades is expected prior to the next overhaul. All alternatives to address these issues require the runner to be removed from the unit. All other scope items identified with this overhaul will be treated as opportunity items.

The current asset health index score of the turbine is 2/10.

Dissection of a field pole in 2014 showed significant degradation in the insulation and the rotor poles have been recommended for re-insulation so that they last until the next overhaul cycle. The current rotor asset health index score is 4.9/10.

Capital Investment Justification

BACKGROUND

The stator wedging is approximately 30 years old and units with similar wedging system within the fleet have been experiencing looseness. It is highly unlikely that the current wedging would last until the next overhaul cycle. The major outage required for the unit work provides the opportunity to re-wedge the stator.

The gates at Grand Rapids require a mobile crane for their complete removal from the water passage for an inspection. The major outage required for the unit work provides the opportunity to remove the gates for proper inspection and address any deficiencies.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

JUSTIFICATION

The investment will mitigate Lost Generation Risk associated with prolonged forced outages caused by the turbine runner, runner-blade fatigue cracking, the rotor, the surface air coolers and the stator wedging system which are in poor condition. Lost Generation Risk will also be mitigated by the installation of the vibration and air gap monitoring probes.

The investment will mitigate Financial Risk associated with repairing damage caused by failure of the stator wedging system which is in poor condition.

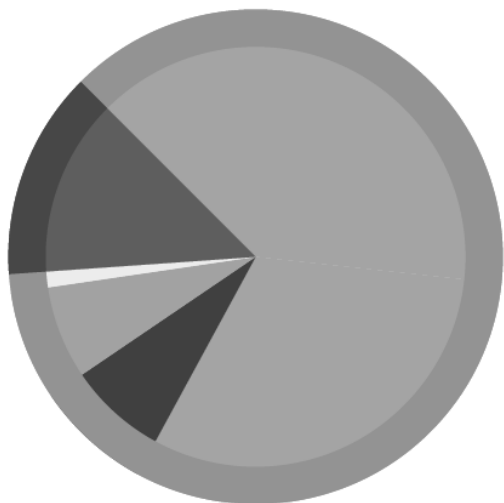
Turbine runner replacement offers a generation revenue benefit due to a shorter required outage duration when compared to the other risk mitigating alternatives studied.

The investment is expected to reduce O&M costs associated with replacing the blade trunnion seals and processing governor oil. Repairing fatigue cracks on the runner blades will be mitigated.

The investment will mitigate Environment Risk associated with a release of governor oil into the Saskatchewan River from the turbine runner hub which is in poor condition.

Capital Investment Justification

CORPORATE VALUE FRAMEWORK



Value Measure	Value Points	% of Value
Lost Generation Risk	77,612	71.66%
Financial Risk	8,373	7.73%
Generation Revenue Benefit	7,484	6.91%
O&M Financial Benefits	1,339	1.24%
Environmental Risk	18	0.02%
Safety Risk	0	0%
Total Cost	-13,479	12.45%
Total Value	81,347	
Value/\$K	6.04	

Capital Investment Justification

ANALYSIS OF ALTERNATIVES:

ECONOMIC ANALYSIS		
Discount Rate	For current corporate rates see P911 6%	

Active Option	NPV Benefits/(Costs)	CVF Score	Value/\$K
Replace Turbine Runner & Overhaul		81,347	6.04

Other Alternatives	NPV Benefits/(Costs)	CVF Score	Value/\$K
A1: Refurbish Turbine Runner Hub & Overhaul		79,737	8.00

INVESTMENT RISK ANALYSIS
<p>Scope:</p> <ul style="list-style-type: none"> During disassembly, there are several minor scope items which have uncertain condition and will be inspected and tested during the outage. Testing has been carried in the budget and schedule. \$300k of contingency has been carried in the event that some of these assets are required to be refurbished or replaced. Additional hazardous material may be identified during the disassembly of the unit. \$150k of contingency has been carried to address this unknown risk in components not accessible during scope development. <p>Schedule:</p> <ul style="list-style-type: none"> There is a risk that multiple existing components including embedments, stator, rotor & other turbine parts may have unforeseen condition which will require some level of refurbishment which could extend the construction schedule. There is a risk that more than anticipated hazardous materials are required to be abated during the disassembly and reassembly stage which could extend the construction schedule. <p>Budget:</p> <ul style="list-style-type: none"> The value of these design, fabrication and construction contracts can be affected by the global demand for Original Equipment Manufacturer (OEM) resources and commodity pricing. The current budget reflects the best information available and includes recent OEM input. A contingency of \$300k is included in the budget for this risk.

Capital Investment Justification

ESTIMATED COST FLOW

The annual projected cost flows are as follows (in thousands of dollars):

Fiscal Year	Budget	Contributions	Net Budget
Prev. Actuals	\$175	\$0	\$175
2022/2023	\$0	\$0	\$0
2023/2024	\$486	\$0	\$486
2024/2025	\$2,149	\$0	\$2,149
2025/2026	\$2,468	\$0	\$2,468
2026/2027	\$5,342	\$0	\$5,342
2027/2028+	\$9,187	\$0	\$9,187
Total	\$19,807	\$0	\$19,807

IMPACT ON O&A COSTS

No additional O&A costs have been identified as a result of this project.

PROPOSED SCHEDULE

April 2023 – Commence Project Execution
August 2024 – Award Runner Supply Contract
June 2027 – Design and Fabrication of new runner
August 2027 – Outage Start Date
March 2028 – Unit 1 ISD

RELATED INVESTMENTS

N/A

OTHER ALTERNATIVES CONSIDERED

The following other alternative was investigated during the Scope Development stage:

- Refurbish the runner hub. The Total Value of this alternative was lower than the Replace runner alternative. This planned outage for this alternative is 7-months longer and extension would be possible caused by issues from fitting the existing blades into the refurbished hub & unforeseen damage to hub internals requiring additional repair or replacement components. Therefore, this alternative was not selected.

REFERENCE DOCUMENTS

[4581 CIC GR Unit 1 Turbine Runner Rehab.docx](#)
[Financial chart GR Unit 1 Turbine Runner Rehab.xlsx](#)

C55-CIC

**CAPITAL INVESTMENT CONCEPT
FOR**

Kettle U5 - U6 and U10 Stator Rewind

Project Category (Project)

SCOPE DEVELOPMENT FUNDS:	\$124
CONCEPT ESTIMATE (incl. Scope Development):	\$76,514
CONTRIBUTIONS:	\$0
NET CONCEPT ESTIMATE (incl. Scope Development):	\$76,514
(values listed above are in thousands of dollars)	
CORPORATE VALUE	Value: 2,896,349
FRAMEWORK SCORE :	Value/\$K: 48.22

DATE PREPARED: 2017/07/10

**EC/MHEB APPROVAL MINUTE &
DATE:**

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
VAN DEN BUSSCHE, JOHN	FINANCIAL FORECASTING SUPERVISOR		Financial Planning	2017/11/17
TURNER, HAL	DIRECTOR GENERATION ASSET MANAGEMENT		Director - Generation Asset Management	2017/07/28
BISHOP, GARY	GEN ASSET STRATEGY & PERF DEPT MANAGER		Generation Asset Strategy and Performanc	2017/07/28
PENNER, KEVIN	MECHANICAL SECTION HEAD		Generation Maintenance and Oper Support	2017/07/28
BORTOLUZZI, LINDSEY	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2017/07/26
ALLARD, KATHLEEN	ASSET INVESTMENT PLANNING SECTION HEAD	On behalf Of HARBER, KRISTINA (krharber).	Generation Asset Strategy and Performanc	2017/07/10
ALLARD, KATHLEEN	ASSET INVESTMENT PLANNING SECTION HEAD		Generation Asset Strategy and Performanc	2017/07/10

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE BUSINESS UNIT:	Generation & Wholesale	REQUESTING BUSINESS UNIT:	Generation & Wholesale
RESPONSIBLE DIVISION:	Engineering Services	REQUESTING DIVISION:	Generation North
RESPONSIBLE DEPARTMENT:	Power Projects		
I.M. NODE NUMBER:	2.1.20.15.02.73	W.B.S. NUMBERS:	P:28749
C55 PROJECT CODE:	13318		
SAP PROJECT TYPE:	23 - BOC-Corporate Asset Mgmt Exec Committee	C55 PROJECT SUB-CATEGORY:	Default
CORPORATE INVESTMENT CATEGORIES:	(Level 1) C3 / Sustainment (Level 2) CM / System Renewal		

CONTACTS			
PREPARED BY:	HARBER, KRISTINA CAPITAL PLANNING ANALYST 51455	REQUESTOR:	Kevin Penner
PROJECT MANAGER:	PAWLUK, JAMES PROJECT MANAGEMENT SECTION HEAD 51460		

MANITOBA HYDRO
CAPITAL INVESTMENT CONCEPT
Kettle U5 - U6 and U10 Stator Rewind

RECOMMENDATION

Approve funding for the scope development phase for replacing or rewinding the Kettle GS Units 5, 6 & 10 generator stators.

SCOPE

The deliverables of the scope development phase will include:

- Preparation of a Concept Design Report
- Preparation of a Project Plan including detailed estimate of scope, budget and schedule for each alternative, project risk mitigation and stakeholder engagement plan
- Detailed investment evaluation within the Corporate Value Framework of all feasible alternative solutions
- Completion of the Capital Investment Justification (CIJ).

BACKGROUND

Recent insulation testing indicates that Units 5, 6 & 10 have significantly lower condition scores than the remaining units.

The Kettle G.S. Units 5-12 generator stators are original to the plant and are nearing the end of their useful life.

Conditions of the units in scope are as follows:

- Unit 5: Poor, assessed at 1.86/10
- Unit 6: Poor, assessed at 3.46/10
- Unit 10: Poor, assessed at 3.46/10

Simply rewinding the existing stator cores is not considered an option. The Toshiba generator stator core design has a very narrow slot so that if rewound as MH has done at other plants, there will be no room for the winding packing that MH typically specifies. The absence of this packing can substantially shorten the winding life. The Toshiba stator frames are quite robust and should be suitable for re-use although this will need to be studied during the CDR phase.

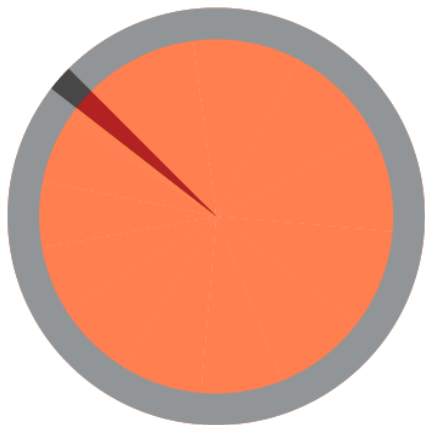
Capital Investment Concept

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

JUSTIFICATION

The asset condition scores of the Kettle Units 5, 6, & 10 generators, exciters and governors continue to degrade over time. It is expected to reduce the reliability and availability of these units as time goes on continually increasing the lost generation risk.

CORPORATE VALUE FRAMEWORK



Value Measure	Value Points	% of Value
Lost Generation Risk Auto	2,915,067	96.64%
Lost Generation Risk	41,000	1.36%
O&M Financial Benefits	351	0.01%
Total Cost	-60,068	1.99%
Total Value	2,896,349	
Value/\$K	48.22	

Capital Investment Concept

OTHER ALTERNATIVES CONSIDERED

The following alternatives should be considered when developing the CDR:
Alternative 1- replacing the stators
Alternative 2 -rewinding & re-coring the stators

PROJECT RISK ANALYSIS

There is a small risk that the value of all alternatives identified will diminish with further evaluation and as scope is developed such that it will no longer be recommended to proceed with this capital investment and all sunk cost will need to be expensed.

ESTIMATED COST FLOW

The annual projected cost flows are as follows (in thousands of dollars):

Fiscal Year	Scope Development Funds	Concept Estimate (Net of Contrib.)	Total Estimated Investment
Prev. Actuals	\$0	\$0	\$0
2017/2018	\$124	\$124	\$124
2018/2019	\$0	\$1,529	\$1,529
2019/2020	\$0	\$10,268	\$10,268
2020/2021	\$0	\$24,074	\$24,074
2021/2022	\$0	\$24,016	\$24,016
2022/2023+	\$0	\$16,503	\$16,503
Total	\$124	\$76,514	\$76,514

Final Inservice Date – March 2023

IMPACT ON O&A COSTS

N/A

RELATED INVESTMENTS

11665 – Kettle Units 7-9 & 11-12 Stator Replacement

REFERENCE DOCUMENTS

C55-CIC-AD

**CAPITAL INVESTMENT CONCEPT ADDENDUM
FOR**

**Kettle Units 5, 6 & 10 Minor Overhaul (Stator)
Investment Type (Project)
Addendum Number 1**

	<u>PREVIOUSLY APPROVED</u>	<u>REVISED</u>	<u>INCREASE / (DECREASE)</u>
SCOPE DEVELOPMENT:	\$125	\$358	\$233
CONCEPT ESTIMATE (incl. Scope Development):	\$76,514	\$83,638	\$7,124
CONTRIBUTIONS:	\$0	\$0	\$0
NET CONCEPT ESTIMATE (incl. Scope Development):	\$76,514	\$83,638	\$7,124
(values listed above are in thousands of dollars)			
CORPORATE VALUE	Value: 2,896,349	Value: 3,460,815	
FRAMEWORK SCORE :	Value/\$K: 48.22	Value/\$K: 41.56	

DATE PREPARED: 2018/12/14

EC/MHEB APPROVAL MINUTE &
DATE:

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
TURNER, HAL	DIRECTOR GENERATION ASSET MANAGEMENT		Director - Generation Asset Management	2018/12/21
BISHOP, GARY	GEN ASSET STRATEGY & PERF DEPT MANAGER		Generation Asset Strategy and Performanc	2018/12/21
MILLER, SANDY	GENERATION PROJECT MANAGEMENT DEPT MGR		Generation Project Management	2018/12/21
Johnson, Erin	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2018/12/20
KJARTANSON, DERRICK	STAFF OFFICER		Generation Project Management	2018/12/17
JENSEN, ROB	ACTING AIP SECTION HEAD	On behalf Of ALLARD, KATHLEEN (kallard).	Generation Asset Strategy and Performanc	2018/12/14

ADDENDUM NUMBER	DATE	REVISION (Summary of change)

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Generation & Wholesale	REQUESTING OPERATING/CORPORATE GROUP:	Generation & Wholesale
RESPONSIBLE DIVISION:	Generation Asset Management	REQUESTING DIVISION:	Generation Operations and Maintenance
RESPONSIBLE DEPARTMENT:	Generation Project Management	ISD: (YYYY/MM/DD)	2019/03/28
I.M. NODE NUMBER:	2.1.20.15.02.73	W.B.S. NUMBERS:	P:30758, P:28749, P:30760, P:30762, P:30697
C55 INVESTMENT CODE:	13318		
SAP PROJECT TYPE:	24 - BOC-VP & Management	C55 INVESTMENT SUB-CATEGORY:	Shell
CORPORATE INVESTMENT CATEGORIZATION:	(Level 1) C3 / Sustainment (Level 2) CM / System Renewal		

CONTACTS			
PREPARED BY:	KJARTANSON, DERRICK STAFF OFFICER 51460	REQUESTOR:	SYLVESTRE, JORDAN (jsylvestre)
PROJECT MANAGER:	MISURA, LYLE PROJECT ENGINEER 51460		

MANITOBA HYDRO
CAPITAL INVESTMENT CONCEPT ADDENDUM
Kettle Units 5, 6 & 10 Minor Overhaul (Stator)

RECOMMENDATION

Increase the budget by \$233k to \$358k for the scope development phase to include potential additional assets that could be refurbished or replaced during a unit minor overhaul along with the generator stators, excitation and governor systems for Units 5, 6 & 10 at Kettle GS.

SCOPE

Added scope:

- outage investigation assessments
- review of additional components

Additional component evaluation:

- intake gates
- generator terminal cubicle (GTC)
- excitation transformer
- station service transformer and current transformers (CT's)
- generator oil leakage containment

Scope development includes:

- creation of a project decision log,
- preparation of issue investigation reports (IIR);
- preparation of a project plan including detailed estimate of scope, budget and schedule for each alternative, project risk mitigation and stakeholder engagement plan;
- detailed investment evaluation within the corporate value framework of all feasible alternative solutions; and
- completion of the capital investment justification (CIJ).

Original component evaluation:

- generator stators
- excitation system
- governor system

BACKGROUND

Given the significant duration and disassembly required to address failures points, it is optimal to work simultaneously on addressing known issues and value added opportunities that achieve corporate values of reducing operating and maintenance, mitigating lost generation, financial and safety risks until the next major maintenance cycle.

Outage investigation of the generator condition was not originally included in scope development but is required to accurately determine stator condition to establish viable refurbishment replacement options.

Capital Investment Concept Addendum

BACKGROUND

The list of additional possible scope items for this project has expanded based on the review of JobTrac and input from the project team. As such, the effort required to accurately develop viable scope options has been greater than originally anticipated.

Generator condition of the units in scope are as follows:

Unit 5: Poor, assessed at 1.86/10

Unit 6: Poor, assessed at 3.46/10

Unit 10: Poor, assessed at 3.46/10

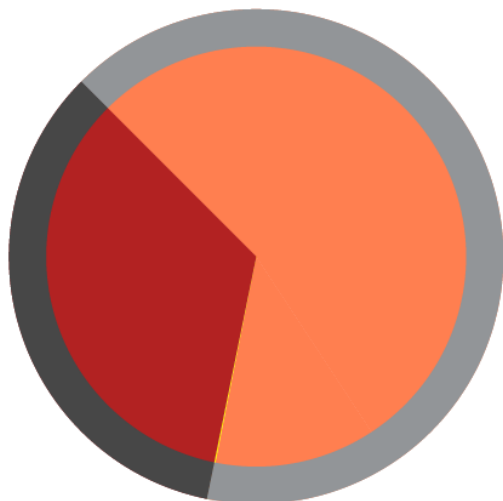
JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

JUSTIFICATION

Lost generation risk - the asset condition scores of the Kettle Units 5, 6, & 10 generators, exciters and governors continue to degrade over time. This is expected to reduce the reliability and availability of these units as time goes on, continually increasing the lost generation risk. Unit 5 was forced out of service due to a failed stator coil; this is the third generator failure in the past five years on this unit.

Capital Investment Concept Addendum

CORPORATE VALUE FRAMEWORK (REVISED)



Value Measure	Value Points	% of Value
Lost Generation Risk	3,543,726	97.69%
O&M Financial Benefits	369	0.01%
Environmental Risk	0	0%
Safety Risk	0	0%
Total Cost	-83,280	2.30%
Total Value	3,460,815	
Value/\$K	41.56	

Capital Investment Concept Addendum

OTHER ALTERNATIVES CONSIDERED

Alternatives will be developed and addressed within the scope development phase. Combinations or separations of scope items will be reviewed during the corporate value framework evaluation process.

INVESTMENT RISK ANALYSIS

There is a small risk that the value of all alternatives identified will diminish with further evaluation and as scope is developed such that it will no longer be recommended to proceed with this capital investment and all sunk cost will need to be expensed.

MANITOBA HYDRO
CAPITAL INVESTMENT CONCEPT ADDENDUM
Kettle Units 5, 6 & 10 Minor Overhaul (Stator)

ESTIMATED COST FLOW									
The annual projected cost flows are as follows (in thousands of dollars):									
PREVIOUSLY APPROVED			PROPOSED			INCREASE/ (DECREASE)			
Fiscal Year	Scope Development Funds	Concept Estimate	Total Estimated Investment (Net of Contrib.)	Scope Development Funds	Concept Estimate	Total Estimated Investment (Net of Contrib.)	Scope Development Funds	Concept Estimate	Total Estimated Investment (Net of Contrib.)
Prev. Actuals/ Approved	\$124	\$124	\$124	\$8	\$8	\$8	(\$116)	(\$116)	(\$116)
2018/2019	\$1	\$1,529	\$1,529	\$350	\$350	\$350	\$349	(\$1,179)	(\$1,179)
2019/2020	\$0	\$10,268	\$10,268	\$0	\$986	\$986	\$0	(\$9,282)	(\$9,282)
2020/2021	\$0	\$24,074	\$24,074	\$0	\$2,748	\$2,748	\$0	(\$21,326)	(\$21,326)
2021/2022	\$0	\$24,016	\$24,016	\$0	\$10,428	\$10,428	\$0	(\$13,588)	(\$13,588)
2022/2023+	\$0	\$16,503	\$16,503	\$0	\$69,118	\$69,118	\$0	\$52,615	\$52,615
Total	\$125	\$76,514	\$76,514	\$358	\$83,638	\$83,638	\$233	\$7,124	\$7,124

IMPACT ON O&A COSTS
Operating and administrative cost impacts cannot be determined at this time; they will be evaluated once the project scope has been fully determined.

MANITOBA HYDRO
CAPITAL INVESTMENT CONCEPT ADDENDUM
Kettle Units 5, 6 & 10 Minor Overhaul (Stator)

RELATED INVESTMENTS

11665 – Kettle Units 7-9 & 11-12 Stator Replacement

REFERENCE DOCUMENTS

[13318 CIC Kettle U5 - U6 and U10 Stator .docx](#)

C55-CIJ-PROJ

**CAPITAL INVESTMENT JUSTIFICATION
FOR**

Kettle Unit 5 Overhaul

Investment Type (Project)

BUDGET:	\$26,733
CONTRIBUTIONS:	\$0
NET BUDGET:	\$26,733
(values listed above are in thousands of dollars)	
CORPORATE VALUE	Value: 118,305
FRAMEWORK SCORE:	Value/\$K: 5.26

DATE PREPARED: 2019/04/16

**EC/MHEB APPROVAL MINUTE &
DATE:**

Approved by EC on June 10,
2019
Minute #: 1702.03

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
MIDFORD, LORNE	VP GENERATION & WHOLESALE		VP Generation & Wholesale	2019/05/17
TURNER, HAL	DIRECTOR GENERATION ASSET MANAGEMENT		Director - Generation Asset Management	2019/05/16
Kreml, John	DIRECTOR GENERATION OPERATIONS & MTCE		Director - Generation Ops & Maintenance	2019/05/16
PLAYFORD, TOM	NORTHERN GENERATION DEPARTMENT MANAGER		Lower Nelson River Operations	2019/05/13
BISHOP, GARY	GEN ASSET STRATEGY & PERF DEPT MANAGER		Generation Asset Strategy and Performanc	2019/05/04
PAWLUK, JAMES	PROJECT MANAGEMENT SECTION HEAD	On behalf Of MILLER, SANDY (sgmiller).	Generation Project Management	2019/05/03
AUSTMAN, JORDAN	PROJECT MANAGEMENT SECTION HEAD		Generation Project Management	2019/05/02
Johnson, Erin	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2019/05/02
KJARTANSON, DERRICK	STAFF OFFICER	On behalf Of EDWARDS, ALAINA (aedwards).	Generation Project Management	2019/04/16
ALLARD, KATHLEEN	PORTFOLIO PLANNER		Generation Asset Strategy and Performanc	2019/04/16

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Generation & Wholesale	REQUESTING OPERATING/CORPORATE GROUP:	Generation & Wholesale
RESPONSIBLE DIVISION:	Generation Asset Management	REQUESTING DIVISION:	Generation Operations and Maintenance
RESPONSIBLE DEPARTMENT:	Generation Project Management	ISD: (YYYY/MM/DD)	2023/01/31
I.M. NODE NUMBER:	2.1.20.15.02.73	W.B.S. NUMBERS:	P:30758, P:28749
C55 INVESTMENT CODE:	13318		
SAP PROJECT TYPE:	22 - BOC- Executive Committee	C55 INVESTMENT SUB-CATEGORY:	Shell
CORPORATE INVESTMENT CATEGORIES:	(Level 1) C3 / Sustainment (Level 2) CM / System Renewal		

CONTACTS			
PREPARED BY:	KJARTANSON, DERRICK STAFF OFFICER 51460	REQUESTOR:	SYLVESTRE, JORDAN (jsylvestre)
PROJECT MANAGER:	MISURA, LYLE PROJECT ENGINEER 51460		

MANITOBA HYDRO
CAPITAL INVESTMENT JUSTIFICATION
Kettle Unit 5 Overhaul (Stator)

RECOMMENDATION

Approve a budget of \$26.7M to complete an overhaul on Unit 5 at Kettle Generating Station to extend its useful life.

SCOPE

The scope of work includes:

- Generator: replace the stator, refurbish the rotor, auxiliary system upgrades.
- Turbine: shaft seal replacement, bearing refurbishment and head cover sump piping replacement.
- Electrical Upgrades: excitation system, unit control and monitoring system (UCMS), governor system, unit protection system, unit synchronizing system, and refurbishment of the generator terminal cubicle (GTC).
- Intake gates: dogging beam replacement, sill seal replacement, riparian valve installation and hydraulic gate hose replacement.

The scope of work excludes work to the wicket gate operating system, runner, water passage, turbine/generator shaft, GSU transformers, or the dewatering header piping.

BACKGROUND

Kettle Units 5 is original to the station and has been in-service for over 45 years. Recent insulation testing indicates the unit is in poor condition, with major component condition indices as low as 1.86 out of 10.

The stator has already experienced multiple stator winding failures and reactive repairs to return the unit to service. Another in-service failure will certainly result in a 2-10 week outage to repair, but could result in an irreparable failure, that would result in the unit being out of service from 1.5 to 3 years.

The protection and control systems are also experiencing reduced reliability and causing regularly recurring forced outages on the unit. Much of the equipment is now obsolete, and no longer supported by their Original Equipment Manufacturers (OEMs). Spare parts can no longer be procured through conventional means.

The Turbine shaft seal is in poor condition due to corrosion and a badly worn sleeve resulting in repeat forced outages to replace the carbon seals.

Finally, the unit is experiencing issues with scroll case de-watering and watering-up, causing extensions to maintenance outages. The dogging beams are undersized, have been submerged for the life of the unit, and are no longer in a usable condition.

A Capital Investment Concept (CIC) was raised to review the options for replacing or rewinding the Kettle GS Units 5,6 & 10 generator stators and identify the assets to be refurbished or replaced during a unit overall. It was determined to proceed only with Unit 5 at this time as a result of the optimizer providing greater value by scheduling individual unit investments in time rather than having all three occur sequentially as one investment. Kettle Units 6 and 10 will be raised as separate investments.

Capital Investment Justification

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

JUSTIFICATION

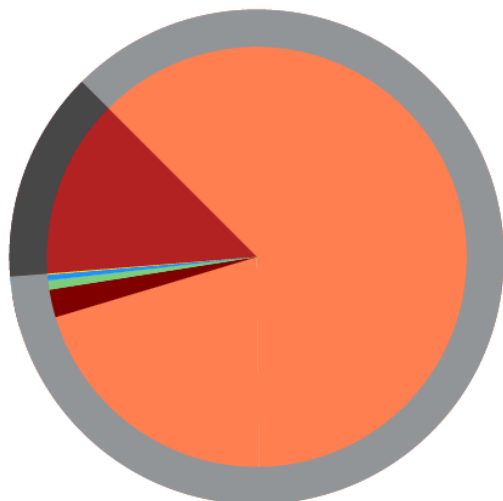
This investment will maximize the value of Unit 5 at the Kettle Generating station by returning assets to good or very good condition to improve availability and reliability.

The work will mitigate the lost generation risk associated with the pending major failures of generation core equipment and its consequential financial damage. Major failures often result in damage that cannot be repaired and returned to service, resulting in extended forced outages, ranging from months to years.

This work also improves the unit's reliability and availability, by reducing the regularly occurring reactive repairs through replacement or refurbishment of equipment currently causing forced outages.

Capital Investment Justification

CORPORATE VALUE FRAMEWORK



Value Measure	Value Points	% of Value
Lost Generation Risk	135,295	82.86%
Financial Risk	3,494	2.14%
Environmental Risk	1,172	0.72%
Safety Risk	699	0.43%
O&M Financial Benefits	142	0.09%
Total Cost	-22,497	13.76%
Total Value	118,305	
Value/\$K	5.26	

Capital Investment Justification

ANALYSIS OF ALTERNATIVES:

ECONOMIC ANALYSIS		
Discount Rate	For current corporate rates see P911 6%	

Active Option	NPV Benefits/(Costs)	CVF Score	Value/\$K
Recommended		118,305	5.26

Other Alternatives	NPV Benefits/(Costs)	CVF Score	Value/\$K

INVESTMENT RISK ANALYSIS
<p>Scope:</p> <ul style="list-style-type: none"> There is a risk that work packages may be introduced after the CIJ approval including; the design and installation of a full vibration monitoring system, which is dependent on-development of corporate guidelines; and the intake gate J-seal replacement, dependent upon findings of further investigations. No contingency is included for these risks. <p>Schedule:</p> <ul style="list-style-type: none"> There is a risk that one of the other stators in the Kettle station may have a catastrophic failure that would require the stator replacement move to that unit; there is a risk the outage gets moved or delayed due to unforeseen circumstances with other generating stations or transmission issues and Manitoba Hydro would continue to carry the associated lost generation risk. No contingency is included for these risks. <p>Budget:</p> <ul style="list-style-type: none"> The value of this contract can be affected by the global demand for OEM resources and commodity pricing. The current budget reflects the best information available and includes recent OEM input. A contingency of \$400k is included in the budget for this risk. The value of the mechanical contract may vary with market conditions, Indigenous training requirements or a Direct Negotiated Contract (DNC) impacts. A contingency of \$200k is included in the budget for this risk. Room availability at Kettle Camp may be limited if other major projects in the Lower Nelson River area (Keeyask, Limestone, and Long Spruce) are executing at the same time, and there may not be rooms available in the Kettle Camp for all the workers required to complete the work. If contractors have to provide their own accommodations, the cost to MH will increase. Other projects will be monitored and coordinated, but overlap is possible. No budget contingency has been included for this risk.

Capital Investment Justification

ESTIMATED COST FLOW			
The annual projected cost flows are as follows (in thousands of dollars):			
Fiscal Year	Budget	Contributions	Net Budget
Prev. Actuals	\$311	\$0	\$311
2019/2020	\$1,024	\$0	\$1,024
2020/2021	\$3,923	\$0	\$3,923
2021/2022	\$6,270	\$0	\$6,270
2022/2023	\$15,204	\$0	\$15,204
2023/2024	\$0	\$0	\$0
2024/2025+	\$0	\$0	\$0
Total	\$26,733	\$0	\$26,733

IMPACT ON O&A COSTS

New and refurbished equipment will replace old, obsolete equipment in poor condition, which will reduce the operating and maintenance (O&M) costs required to maintain Unit 5.

O&M costs were considered in the evaluation of all the items included in the scope. No options selected would increase the O&M requirements.

PROPOSED SCHEDULE

2019 May – Start project
2020 April – Award stator contract
2022 February to May – Build new stator, frame and core
2022 July to 2023 January – Outage to replace stator and complete associated work
2023 January – Unit 5 ISD

RELATED INVESTMENTS

Kettle Unit 6 Minor Overhaul P:30760 CL 21203
Kettle Unit 10 Minor Overhaul P:30762 CL 21204

OTHER ALTERNATIVES CONSIDERED

The Kettle Unit 5 overhaul investment has many permutations and combinations of scope items for consideration. Scope item inclusion decisions and scope item alternatives were evaluated and the combinations assessed. Due to the number of resulting investment alternatives it is not feasible to document all of them in the CIJ.

The most material scope item alternative identified was the option to refurbish the stator in place (new windings, re-use the core and frame), but this was discounted due to:

- The lost revenue due to the extended time the unit would be out of service (additional 7 weeks minimum) for an in situ rewind is greater than the additional cost of a new frame and core.

Capital Investment Justification

OTHER ALTERNATIVES CONSIDERED

- Risk to the outage duration when completing a rewind on an existing stator frame and core is unknown. Any additional repairs required to core and frame would extend the outage and increase lost generation revenue.

REFERENCE DOCUMENTS

[13318 CIC Kettle U5 - U6 and U10 Stator .docx](#)

[13318 CIC AD KT Units 5, 6 10 Minor OVHL 1.docx](#)

[Financial Chart P30758 KT U5 OH April 2019.xlsx](#)

C55-CIJ-PROJ

**CAPITAL INVESTMENT JUSTIFICATION
FOR**

Kettle Unit 10 Minor Overhaul

Investment Type (Project)

BUDGET:	\$23,334
CONTRIBUTIONS:	\$0
NET BUDGET:	\$23,334
(values listed above are in thousands of dollars)	
CORPORATE VALUE	Value: 115,155
FRAMEWORK SCORE:	Value/\$K: 6.75

DATE PREPARED: 2019/09/17

**EC/MHEB APPROVAL MINUTE &
DATE:**

Approved at CAMEC
December 18, 2019

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
Midford, Lorne	VP GENERATION & WHOLESALE		VP Generation & Wholesale	2019/11/22
Turner, Hal	DIRECTOR GENERATION ASSET MANAGEMENT		Director - Generation Asset Management	2019/11/11
Kreml, John	DIRECTOR GENERATION OPERATIONS & MTCE		Director - Generation Ops & Maintenance	2019/11/07
Playford, Tom	NORTHERN GENERATION DEPARTMENT MANAGER		Lower Nelson River Operations	2019/11/07
Bishop, Gary	GEN ASSET STRATEGY & PERF DEPT MANAGER		Generation Asset Strategy and Performanc	2019/10/28
Miller, Sandy	GENERATION PROJECT MANAGEMENT DEPT MGR		Generation Project Management	2019/10/28
Austman, Jordan	PROJECT MANAGEMENT SECTION HEAD		Generation Project Management	2019/10/25
Johnson, Erin	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2019/10/25
Edwards, Alaina	PROJECT CONTROL & REPORTING OFFICER		Generation Project Management	2019/09/17
Allard, Kathleen	PORTFOLIO PLANNER		Generation Asset Strategy and Performanc	2019/09/17

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Generation & Wholesale	REQUESTING OPERATING/CORPORATE GROUP:	Generation & Wholesale
RESPONSIBLE DIVISION:	Generation Asset Management	REQUESTING DIVISION:	Generation Asset Management
RESPONSIBLE DEPARTMENT:	Generation Project Management	ISD: (YYYY/MM/DD)	2025/03/31
I.M. NODE NUMBER:	2.1.20.15.02.86	W.B.S. NUMBERS:	P:30762
C55 INVESTMENT CODE:	21204		
SAP PROJECT TYPE:	23 – BOC-Corporate Asset Management Executive Committee	C55 INVESTMENT SUB-CATEGORY:	Single WBS
CORPORATE INVESTMENT CATEGORIES:	(Level 1) C3 / Sustainment (Level 2) CM / System Renewal		

CONTACTS			
PREPARED BY:	Edwards, Alaina STAFF OFFICER 51460	REQUESTOR:	SYLVESTRE, JORDAN (jsylvestre)
PROJECT MANAGER:	Misura, Lyle PROJECT ENGINEER 51460		

MANITOBA HYDRO
CAPITAL INVESTMENT JUSTIFICATION
Kettle Unit 10 Minor Overhaul

RECOMMENDATION

Approve a budget of \$23.3M to complete an overhaul on Unit 10 at Kettle Generating Station to extend its useful life.

SCOPE

The scope of work includes:

- Generator - replace the stator, refurbish the rotor & auxiliary system upgrades.
- Turbine - shaft seal replacement, bearing refurbishment and head cover sump piping replacement.
- Electrical Upgrades - excitation system, unit control and monitoring system (UCMS), governor system, unit protection system, unit synchronizing system, and refurbishment of the generator terminal cubicle (GTC).
- Intake gates - dogging beam replacement, sill seal replacement, riparian valve installation and hydraulic gate hose replacement.

The scope of work excludes work to the wicket gate operating system, runner, water passage, turbine/generator shaft, GSU transformers, or the dewatering header piping.

BACKGROUND

Kettle Unit 10 is original to the station and has been in-service for over 45 years. Recent insulation testing indicates the unit is in poor condition, with major component condition indices as low as 3.46 out of 10.

Stators in Kettle have experienced multiple stator winding failures and reactive repairs to return the units to service. Any in-service failure will result in a 2-10 week outage to repair, but could result in an irreparable failure, that would result in the unit being out of service from 1.5 to 3 years.

The protection and control systems are also experiencing reduced reliability and causing regularly recurring forced outages on the unit. Much of the equipment is now obsolete, and no longer supported by their Original Equipment Manufacturers (OEMs). Spare parts are no longer available from the OEM and if acquired cannot be guaranteed for fit or function from the third party suppliers.

The Turbine shaft seal is in poor condition due to corrosion and a badly worn sleeve resulting in repeat forced outages to replace the carbon seals.

The unit is experiencing issues with scroll case de-watering and watering-up, causing extensions to maintenance outages. The dogging beams are undersized, have been submerged for the life of the unit, and are no longer in a usable condition.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

JUSTIFICATION

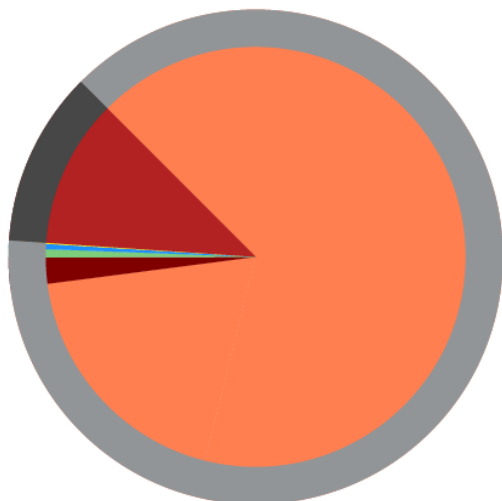
The Kettle Unit 10 assets are in poor condition with declining reliability and high potential costs of in-service failure. Overhauling the unit will mitigate the lost generation risk and its consequential financial losses with approximately a 6:1 benefit-cost ratio.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

Major failures of generation core equipment often result in damage that cannot be repaired and returned to service, resulting in extended forced outages, ranging from months to years.

Capital Investment Justification

CORPORATE VALUE FRAMEWORK



Value Measure	Value Points	% of Value
Lost Generation Risk	127,549	85.45%
Financial Risk	2,991	2%
Environmental Risk	947	0.63%
Safety Risk	598	0.4%
O&M Financial Benefits	121	0.08%
Total Cost	-17,052	11.42%
Total Value	115,155	
Value/\$K	6.75	

Capital Investment Justification

ANALYSIS OF ALTERNATIVES:

ECONOMIC ANALYSIS		
Discount Rate	For current corporate rates see P911 6%	

Active Option	NPV Benefits/(Costs)	CVF Score	Value/\$K
Replace Generator Stators		115,155	6.75

Other Alternatives	NPV Benefits/(Costs)	CVF Score	Value/\$K
See Other Alternatives Considered section			

INVESTMENT RISK ANALYSIS
<p>Scope:</p> <ul style="list-style-type: none"> There is a risk that work packages may be introduced after the CIJ approval including; the design and installation of a full vibration monitoring system, which is dependent on development of corporate guidelines; and the intake gate J-seal replacement, dependent upon findings of further investigations. No contingency is included for these risks. <p>Schedule:</p> <ul style="list-style-type: none"> There is a risk that one of the other stators in the Kettle station may have a catastrophic failure that would require the stator replacement move to that unit; there is a risk the outage gets moved or delayed due to unforeseen circumstances with other generating stations or transmission issues and Manitoba Hydro would continue to carry the associated lost generation risk. No contingency is included for these risks. <p>Budget:</p> <ul style="list-style-type: none"> The value of this contract can be affected by the global demand for OEM resources and commodity pricing. The current budget reflects the best information available and includes recent OEM input. A contingency of \$400k is included in the budget for this risk. The value of the mechanical contract may vary with market conditions, Indigenous training requirements or a Direct Negotiated Contract (DNC) impacts. A contingency of \$200k is included in the budget for this risk. If other major projects in the Lower Nelson River area are executing at the same time, there may be a lack of vacancy in the Kettle Camp for all the workers required to complete work. No budget contingency has been included. Other projects will be monitored and coordinated as much as possible.

Capital Investment Justification

ESTIMATED COST FLOW

The annual projected cost flows are as follows (in thousands of dollars):

Fiscal Year	Budget	Contributions	Net Budget
Prev. Actuals	\$0	\$0	\$0
2022/2023	\$2,668	\$0	\$2,668
2023/2024	\$6,408	\$0	\$6,408
2024/2025	\$14,104	\$0	\$14,104
2025/2026	\$155	\$0	\$155
2026/2027	\$0	\$0	\$0
2027/2028+	\$0	\$0	\$0
Total	\$23,334	\$0	\$23,334

IMPACT ON O&A COSTS

New and refurbished equipment will replace old, obsolete and equipment in poor condition, which will reduce the O&M costs required to maintain Unit 10.

O&M costs were considered in the evaluation of all the items included in the scope. No options selected would increase the O&M requirements.

PROPOSED SCHEDULE

2024 February to May – Build new stator, frame and core
2024 July to 2025 January – Outage to Replace stator and complete associated work
2025 January – Unit 10 ISD

RELATED INVESTMENTS

Kettle Unit 5 Minor Overhaul P:30758 CL 13318
Kettle Unit 6 Minor Overhaul P:30762 CL 21203
Kettle Unit 8 Minor Overhaul P:32909 CL 23174

OTHER ALTERNATIVES CONSIDERED

The Kettle Unit 10 overhaul investment has many permutations and combinations of scope items for consideration. Scope item inclusion decisions and scope item alternatives were evaluated, and the combinations assessed. Due to the number of resulting investment alternatives it is not feasible to document all of them in the CIJ.

The most material scope item alternative identified was the option to refurbish the stator in place (new windings, re-use the core and frame), but this was discounted due to:

- The lost revenue due to the extended time the unit would be out of service (additional 7 weeks minimum) for a

Capital Investment Justification

OTHER ALTERNATIVES CONSIDERED

rewind is greater than the additional cost of a new frame and core.

- Risk to the outage duration when completing a rewind on an existing stator frame and core is unknown. Any additional repairs required to core and frame would extend the outage and increase lost generation revenue.

REFERENCE DOCUMENTS

[Financial Chart P30762 KT U10 OH 2019.xlsx](#)

C55-CIJ-PROJ

**CAPITAL INVESTMENT JUSTIFICATION
FOR**

Kettle Unit 8 Minor Overhaul

Investment Type (Project)

BUDGET:	\$23,484
CONTRIBUTIONS:	\$0
NET BUDGET:	\$23,484
(values listed above are in thousands of dollars)	
CORPORATE VALUE	Value: 100,536
FRAMEWORK SCORE:	Value/\$K: 6.23

DATE PREPARED: 2019/10/01

**EC/MHEB APPROVAL MINUTE &
DATE:**

Approved at CAMEC
December 18, 2019

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
Midford, Lorne	VP GENERATION & WHOLESALE		VP Generation & Wholesale	2019/11/22
Turner, Hal	DIRECTOR GENERATION ASSET MANAGEMENT		Director - Generation Asset Management	2019/11/11
Kreml, John	DIRECTOR GENERATION OPERATIONS & MTCE		Director - Generation Ops & Maintenance	2019/11/07
Playford, Tom	NORTHERN GENERATION DEPARTMENT MANAGER		Lower Nelson River Operations	2019/11/07
Bishop, Gary	GEN ASSET STRATEGY & PERF DEPT MANAGER		Generation Asset Strategy and Performanc	2019/10/28
Miller, Sandy	GENERATION PROJECT MANAGEMENT DEPT MGR		Generation Project Management	2019/10/28
Austman, Jordan	PROJECT MANAGEMENT SECTION HEAD		Generation Project Management	2019/10/25
Johnson, Erin	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2019/10/25
Edwards, Alaina	PROJECT CONTROL & REPORTING OFFICER		Generation Project Management	2019/10/02
Jensen, Rob	ASSET PLANNING SUPPORT SECTION HEAD	On behalf Of Allard, Kathleen (kallard).	Generation Asset Strategy and Performanc	2019/10/01

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Generation & Wholesale	REQUESTING OPERATING/CORPORATE GROUP:	Generation & Wholesale
RESPONSIBLE DIVISION:	Generation Asset Management	REQUESTING DIVISION:	Generation Asset Management
RESPONSIBLE DEPARTMENT:	Generation Project Management	ISD: (YYYY/MM/DD)	2025/12/31
I.M. NODE NUMBER:	2.1.20.15.02.91	W.B.S. NUMBERS:	P:32909
C55 INVESTMENT CODE:	23174		
SAP PROJECT TYPE:	23 - BOC-Corporate Asset Management Executive Committee	C55 INVESTMENT SUB-CATEGORY:	Single WBS
CORPORATE INVESTMENT CATEGORIES:	(Level 1) C3 / Sustainment (Level 2) CM / System Renewal		

CONTACTS			
PREPARED BY:	Edwards, Alaina PROJECT CONTROL & REPORTING OFFICER 51460	REQUESTOR:	SYLVESTRE, JORDAN (jsylvestre)
PROJECT MANAGER:	Misura, Lyle PROJECT ENGINEER 51460		

MANITOBA HYDRO
CAPITAL INVESTMENT JUSTIFICATION
Kettle Unit 8 Minor Overhaul

RECOMMENDATION

Approve a budget of \$23.5M to complete an overhaul on Unit 8 at Kettle Generating Station to extend its useful life.

SCOPE

The scope of work includes:

- Generator - replace the stator, refurbish the rotor & auxiliary system upgrades.
- Turbine - shaft seal replacement, bearing refurbishment and head cover sump piping replacement.
- Electrical Upgrades - excitation system, unit control and monitoring system (UCMS), governor system, unit protection system, unit synchronizing system, and refurbishment of the generator terminal cubicle (GTC).
- Intake gates - dogging beam replacement, sill seal replacement, riparian valve installation and hydraulic gate hose replacement.

The scope of work excludes work to the wicket gate operating system, runner, water passage, turbine/generator shaft, GSU transformers, or the dewatering header piping.

BACKGROUND

Kettle Units 8 is original to the station and has been in-service for over 45 years. Recent insulation testing indicates the unit is in poor condition, with major component condition indices as low as 3.46 out of 10.

Stators in Kettle have experienced multiple stator winding failures and reactive repairs to return the units to service. Any in-service failure will result in a 2-10 week outage to repair, but could result in an irreparable failure, that would result in the unit being out of service from 1.5 to 3 years.

The protection and control systems are also experiencing reduced reliability and causing regularly recurring forced outages on the unit. Much of the equipment is now obsolete, and no longer supported by their Original Equipment Manufacturers (OEMs). Spare parts are no longer available from the OEM and if acquired can not be guaranteed for fit or function from the third party suppliers.

The Turbine shaft seal is in poor condition due to corrosion and a badly worn sleeve resulting in repeat forced outages to replace the carbon seals.

The unit is experiencing issues with scroll case de-watering and watering-up, causing extensions to maintenance outages. The dogging beams are undersized, have been submerged for the life of the unit, and are no longer in a usable condition.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

JUSTIFICATION

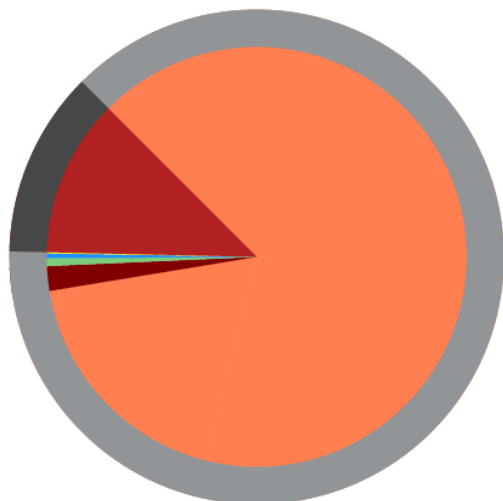
The Kettle Unit 8 assets are in poor condition with declining reliability and high potential costs of in-service failure. Overhauling the unit will mitigate the lost generation risk and its consequential financial losses with approximately a 6:1 benefit-cost ratio.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

Major failures of generation core equipment often result in damage that cannot be repaired and returned to service, resulting in extended forced outages, ranging from months to years.

Capital Investment Justification

CORPORATE VALUE FRAMEWORK



Value Measure	Value Points	% of Value
Lost Generation Risk	112,743	84.9%
Financial Risk	2,515	1.89%
Environmental Risk	796	0.6%
Safety Risk	503	0.38%
O&M Financial Benefits	105	0.08%
Total Cost	-16,126	12.14%
Total Value	100,536	
Value/\$K	6.23	

Capital Investment Justification

ANALYSIS OF ALTERNATIVES:

ECONOMIC ANALYSIS		
Discount Rate	For current corporate rates see P911 6%	

Active Option	NPV Benefits/(Costs)	CVF Score	Value/\$K
Replace Generator Stators		100,536	6.23

Other Alternatives	NPV Benefits/(Costs)	CVF Score	Value/\$K
See Other Alternatives Considered section			

INVESTMENT RISK ANALYSIS

Scope:

- There is a risk that work packages may be introduced after the CIJ approval adding to the scope of the project including; the design and installation of a full vibration monitoring system, which is dependent on development of corporate guidelines; and the intake gate J-seal replacement, dependent upon findings of further investigations. No contingency is included for these risks.

Schedule:

- There is a risk that one of the other stators in the Kettle station may have a catastrophic failure that would require the stator replacement move to that unit; there is a risk the outage gets moved or delayed due to unforeseen circumstances with other generating stations or transmission issues and Manitoba Hydro would continue to carry the associated lost generation risk. No contingency is included for these risks.

Budget:

- The value of this contract can be affected by the global demand for OEM resources and commodity pricing. The current budget reflects the best information available and includes recent OEM input. A contingency of \$400k is included in the budget for this risk.
- The value of the mechanical contract may vary with market conditions, Indigenous training requirements or Direct Negotiated Contract (DNC) impacts. A contingency of \$200k is included in the budget for this risk.
- If other major projects in the Lower Nelson River area are executing at the same time, there may be a lack of vacancy in the Kettle Camp for all the workers required to complete work. No budget contingency has been included. Other projects will be monitored and coordinated as much as possible.

Capital Investment Justification

ESTIMATED COST FLOW			
The annual projected cost flows are as follows (in thousands of dollars):			
Fiscal Year	Budget	Contributions	Net Budget
Prev. Actuals	\$0	\$0	\$0
2023/2024	\$2,351	\$0	\$2,351
2024/2025	\$6,934	\$0	\$6,934
2025/2026	\$14,013	\$0	\$14,013
2026/2027	\$184	\$0	\$184
2027/2028	\$0	\$0	\$0
2028/2029+	\$0	\$0	\$0
Total	\$23,484	\$0	\$23,484

IMPACT ON O&A COSTS

New and refurbished equipment will replace old, obsolete and equipment in poor condition, which will reduce the O&M costs required to maintain Unit 8.

O&M costs were considered in the evaluation of all the items included in the scope. No options selected would increase the O&M requirements.

PROPOSED SCHEDULE

2020 April – Award Stator Contract
2025 February to May – Build new stator, frame and core
2025 July to 2026 January – Outage to Replace stator and complete associated work
2026 January – Unit 8 ISD

RELATED INVESTMENTS

Kettle Unit 5 Minor Overhaul P:30758 CL 13318
Kettle Unit 10 Minor Overhaul P:30762 CL 21204
Kettle Unit 6 Minor Overhaul P:30760 CL 21203

OTHER ALTERNATIVES CONSIDERED

The Kettle Unit 8 overhaul investment has many permutations and combinations of scope items for consideration. Scope item inclusion decisions and scope item alternatives were evaluated and the combinations assessed. Due to the number of resulting investment alternatives it is not feasible to document all of them in the CIJ.

The most material scope item alternative identified was the option to refurbish the stator (new windings, re-use the core and frame), but this was discounted due to:

- The lost revenue due to the extended time the unit would be out of service (additional 7 weeks minimum) for a rewind is greater than the additional cost of a new frame and core.
- Risk to the outage duration when completing a rewind on an existing stator frame and core is unknown. Any additional repairs required to the core and frame would extend the outage and increase lost generation

Capital Investment Justification

OTHER ALTERNATIVES CONSIDERED

revenue.

REFERENCE DOCUMENTS

[Financial Chart P32909 KT U8 OH 2019.xlsx](#)

C55-CIJ-PROJ

**CAPITAL INVESTMENT JUSTIFICATION
FOR**

Kettle Unit 11 Minor Overhaul

Investment Type (Project)

BUDGET:	\$25,937
CONTRIBUTIONS:	\$0
NET BUDGET:	\$25,937
(values listed above are in thousands of dollars)	
CORPORATE VALUE	Value: 76,234
FRAMEWORK SCORE:	Value/\$K: 5.86

DATE PREPARED: 2019/10/04

**EC/MHEB APPROVAL MINUTE &
DATE:**

Approved by Jay Grewal
December 18, 2019

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
Midford, Lorne	VP GENERATION & WHOLESALE		VP Generation & Wholesale	2019/11/22
Turner, Hal	DIRECTOR GENERATION ASSET MANAGEMENT		Director - Generation Asset Management	2019/11/11
Kreml, John	DIRECTOR GENERATION OPERATIONS & MTCE		Director - Generation Ops & Maintenance	2019/11/07
Playford, Tom	NORTHERN GENERATION DEPARTMENT MANAGER		Lower Nelson River Operations	2019/11/07
Bishop, Gary	GEN ASSET STRATEGY & PERF DEPT MANAGER		Generation Asset Strategy and Performanc	2019/10/28
Miller, Sandy	GENERATION PROJECT MANAGEMENT DEPT MGR		Generation Project Management	2019/10/28
Austman, Jordan	PROJECT MANAGEMENT SECTION HEAD		Generation Project Management	2019/10/25
Johnson, Erin	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2019/10/25
Stephenson, Patti-Ann	STAFF OFFICER		Generation Project Management	2019/10/04
Jensen, Rob	ASSET PLANNING SUPPORT SECTION HEAD	On behalf Of Allard, Kathleen (kallard).	Generation Asset Strategy and Performanc	2019/10/04

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Generation & Wholesale	REQUESTING OPERATING/CORPORATE GROUP:	Generation & Wholesale
RESPONSIBLE DIVISION:	Generation Asset Management	REQUESTING DIVISION:	Generation Asset Management
RESPONSIBLE DEPARTMENT:	Generation Project Management	ISD: (YYYY/MM/DD)	2030/12/31
I.M. NODE NUMBER:	2.1.20.15.02.92	W.B.S. NUMBERS:	P:32918
C55 INVESTMENT CODE:	23176		
SAP PROJECT TYPE:	22 – Executive Committee	C55 INVESTMENT SUB-CATEGORY:	Single WBS
CORPORATE INVESTMENT CATEGORIES:	(Level 1) C3 / Sustainment (Level 2) CM / System Renewal		

CONTACTS			
PREPARED BY:	Stephenson, Patti-Ann STAFF OFFICER 51460	REQUESTOR:	SYLVESTRE, JORDAN (jsylvestre)
PROJECT MANAGER:	Misura, Lyle PROJECT ENGINEER 51460		

MANITOBA HYDRO
CAPITAL INVESTMENT JUSTIFICATION
Kettle Unit 11 Minor Overhaul

RECOMMENDATION

Approve a budget of \$25.9M to complete an overhaul on Unit 11 at Kettle Generating Station to extend its useful life.

SCOPE

The scope of work includes:

- Generator - replace the stator, refurbish the rotor & auxiliary system upgrades.
- Turbine - shaft seal replacement, bearing refurbishment and head cover sump piping replacement.
- Electrical Upgrades - excitation system, unit control and monitoring system (UCMS), governor system, unit protection system, unit synchronizing system, and refurbishment of the generator terminal cubicle (GTC).
- Intake gates - dogging beam replacement, sill seal replacement, riparian valve installation and hydraulic gate hose replacement.

The scope of work excludes work to the wicket gate operating system, runner, water passage, turbine/generator shaft, GSU transformers, or the dewatering header piping.

BACKGROUND

Kettle Unit 11 is original to the station and has been in-service for over 45 years. Recent insulation testing indicates the unit is in poor condition.

Stators in Kettle have experienced multiple stator winding failures and reactive repairs to return the units to service. Any in-service failure will result in a 2-10 week outage to repair, but could result in an irreparable failure, that would result in the unit being out of service from 1.5 to 3 years.

The protection and control systems are also experiencing reduced reliability and causing regularly recurring forced outages on the unit. Much of the equipment is now obsolete, and no longer supported by their Original Equipment Manufacturers (OEMs). Spare parts are no longer available from the OEM and if acquired cannot be guaranteed for fit or function from the third party suppliers.

The Turbine shaft seal is in poor condition due to corrosion and a badly worn sleeve resulting in repeat forced outages to replace the carbon seals.

The unit is experiencing issues with scroll case de-watering and watering-up, causing extensions to maintenance outages. The dogging beams are undersized, have been submerged for the life of the unit, and are no longer in a usable condition.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

JUSTIFICATION

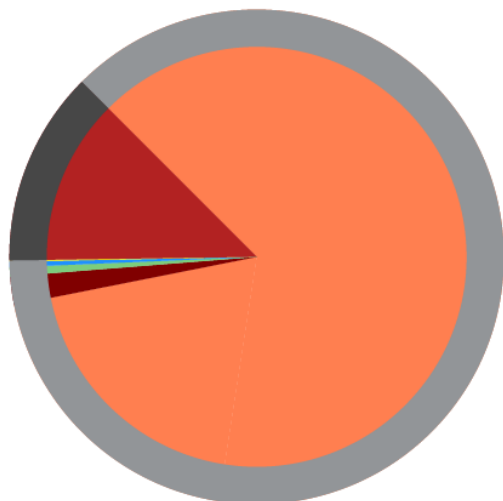
The Kettle Unit 11 assets are in poor condition with declining reliability and high potential costs of in-service failure. Overhauling the unit will mitigate the lost generation risk and its consequential financial losses with approximately a 5:1 benefit-cost ratio.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

Major failures of generation core equipment often result in damage that cannot be repaired and returned to service, resulting in extended forced outages, ranging from months to years.

Capital Investment Justification

CORPORATE VALUE FRAMEWORK



Value Measure	Value Points	% of Value
Lost Generation Risk	86,289	84.38%
Financial Risk	1,894	1.85%
Environmental Risk	600	0.59%
Safety Risk	379	0.37%
O&M Financial Benefits	83	0.08%
Total Cost	-13,012	12.72%
Total Value	76,234	
Value/\$K	5.86	

Capital Investment Justification

ANALYSIS OF ALTERNATIVES:

ECONOMIC ANALYSIS		
Discount Rate	For current corporate rates see P911 6%	

Active Option	NPV Benefits/(Costs)	CVF Score	Value/\$K
Replace Generator Stators		76,234	5.86

Other Alternatives	NPV Benefits/(Costs)	CVF Score	Value/\$K
See Other Alternatives Considered section			

INVESTMENT RISK ANALYSIS
<p>Scope:</p> <ul style="list-style-type: none"> There is a risk that work packages may be introduced after the CIJ approval adding to the scope of the project including; the design and installation of a full vibration monitoring system, which is dependent on development of corporate guidelines; and the intake gate J-seal replacement, dependent upon findings of further investigations. No contingency is included for these risks. <p>Schedule:</p> <ul style="list-style-type: none"> There is a risk that one of the other stators in the Kettle station may have a catastrophic failure that would require the stator replacement move to that unit; there is a risk the outage gets moved or delayed due to unforeseen circumstances with other generating stations or transmission issues and Manitoba Hydro would continue to carry the associated lost generation risk. No contingency is included for these risks. <p>Budget:</p> <ul style="list-style-type: none"> The value of this contract can be affected by the global demand for OEM resources and commodity pricing. The current budget reflects the best information available and includes recent OEM input. A contingency of \$400k is included in the budget for this risk. The value of the mechanical contract may vary with market conditions, Indigenous training requirements or Direct Negotiated Contract (DNC) impacts. A contingency of \$200k is included in the budget for this risk. If other major projects in the Lower Nelson River area are executing at the same time, there may be a lack of vacancy in the Kettle Camp for all the workers required to complete work. No budget contingency has been included. Other projects will be monitored and coordinated as much as possible.

Capital Investment Justification

ESTIMATED COST FLOW			
The annual projected cost flows are as follows (in thousands of dollars):			
Fiscal Year	Budget	Contributions	Net Budget
Prev. Actuals	\$0	\$0	\$0
2026/2027	\$0	\$0	\$0
2027/2028	\$0	\$0	\$0
2028/2029	\$2,630	\$0	\$2,630
2029/2030	\$8,135	\$0	\$8,135
2030/2031	\$14,973	\$0	\$14,973
2031/2032+	\$198	\$0	\$198
Total	\$25,937	\$0	\$25,937

IMPACT ON O&A COSTS
New and refurbished equipment will replace old, obsolete and equipment in poor condition, which will reduce the O&M costs required to maintain the unit. O&M costs were considered in the evaluation of all the items included in the scope. No options selected would increase the O&M requirements.

PROPOSED SCHEDULE
2031 January - Unit 11 ISD

RELATED INVESTMENTS
Kettle Unit 9 Minor Overhaul P:32920 CL23175
Kettle Unit 7 Minor Overhaul P:32912 CL 23173
Kettle Unit 12 Minor Overhaul P:32919 CL23177

OTHER ALTERNATIVES CONSIDERED
The Kettle overhaul investment has many permutations and combinations of scope items for consideration. Scope item inclusion decisions and scope item alternatives were evaluated and the combinations assessed. Due to the number of resulting investment alternatives it is not feasible to document all of them in the CIJ.

The most material scope item alternative identified was the option to refurbish the stator (new windings, re-use the core and frame), but this was discounted due to:

- The lost revenue due to the extended time the unit would be out of service (additional 7 weeks minimum) for a rewind is greater than the additional cost of a new frame and core.
- Risk to the outage duration when completing a rewind on an existing stator frame and core is unknown. Any additional repairs required to the core and frame would extend the outage and increase lost generation revenue.

Capital Investment Justification

REFERENCE DOCUMENTS
Financial Chart P32918 KT U11 OH 2019.xlsx

C55-CIJ-PROJ

**CAPITAL INVESTMENT JUSTIFICATION
FOR**

Kettle Unit 12 Minor Overhaul

Investment Type (Project)

BUDGET:	\$25,416
CONTRIBUTIONS:	\$0
NET BUDGET:	\$25,416
(values listed above are in thousands of dollars)	
CORPORATE VALUE	Value: 83,558
FRAMEWORK SCORE:	Value/\$K: 6.16

DATE PREPARED: 2019/10/04

**EC/MHEB APPROVAL MINUTE &
DATE:**

Approved by Jay Grewal
December 18, 2019

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
Midford, Lorne	VP GENERATION & WHOLESALE		VP Generation & Wholesale	2019/11/22
Turner, Hal	DIRECTOR GENERATION ASSET MANAGEMENT		Director - Generation Asset Management	2019/11/11
Kreml, John	DIRECTOR GENERATION OPERATIONS & MTCE		Director - Generation Ops & Maintenance	2019/11/11
Playford, Tom	NORTHERN GENERATION DEPARTMENT MANAGER		Lower Nelson River Operations	2019/11/07
Bishop, Gary	GEN ASSET STRATEGY & PERF DEPT MANAGER		Generation Asset Strategy and Performanc	2019/10/28
Miller, Sandy	GENERATION PROJECT MANAGEMENT DEPT MGR		Generation Project Management	2019/10/28
Austman, Jordan	PROJECT MANAGEMENT SECTION HEAD		Generation Project Management	2019/10/25
Johnson, Erin	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2019/10/25
Stephenson, Patti-Ann	STAFF OFFICER		Generation Project Management	2019/10/04
Jensen, Rob	ASSET PLANNING SUPPORT SECTION HEAD	On behalf Of Allard, Kathleen (kallard).	Generation Asset Strategy and Performanc	2019/10/04

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Generation & Wholesale	REQUESTING OPERATING/CORPORATE GROUP:	Generation & Wholesale
RESPONSIBLE DIVISION:	Generation Asset Management	REQUESTING DIVISION:	Generation Asset Management
RESPONSIBLE DEPARTMENT:	Generation Project Management	ISD: (YYYY/MM/DD)	2029/12/31
I.M. NODE NUMBER:	2.1.20.15.02.93	W.B.S. NUMBERS:	P:32919
C55 INVESTMENT CODE:	23177		
SAP PROJECT TYPE:	22 – Executive Committee	C55 INVESTMENT SUB-CATEGORY:	Single WBS
CORPORATE INVESTMENT CATEGORIES:	(Level 1) C3 / Sustainment (Level 2) CM / System Renewal		

CONTACTS			
PREPARED BY:	Stephenson, Patti-Ann STAFF OFFICER 51460	REQUESTOR:	SYLVESTRE, JORDAN (jsylvestre)
PROJECT MANAGER:	Misura, Lyle PROJECT ENGINEER 51460		

MANITOBA HYDRO
CAPITAL INVESTMENT JUSTIFICATION
Kettle Unit 12 Minor Overhaul

RECOMMENDATION

Approve a budget of \$25.4M to complete an overhaul on Unit 12 at Kettle Generating Station to extend its useful life.

SCOPE

The scope of work includes:

- Generator - replace the stator, refurbish the rotor & auxiliary system upgrades.
- Turbine - shaft seal replacement, bearing refurbishment and head cover sump piping replacement.
- Electrical Upgrades - excitation system, unit control and monitoring system (UCMS), governor system, unit protection system, unit synchronizing system, and refurbishment of the generator terminal cubicle (GTC).
- Intake gates - dogging beam replacement, sill seal replacement, riparian valve installation and hydraulic gate hose replacement.

The scope of work excludes work to the wicket gate operating system, runner, water passage, turbine/generator shaft, GSU transformers, or the dewatering header piping.

BACKGROUND

Kettle Units 12 is original to the station and has been in-service for over 45 years. Recent insulation testing indicates the unit is in poor condition.

Stators in Kettle have experienced multiple stator winding failures and reactive repairs to return the units to service. Any in-service failure will result in a 2-10 week outage to repair, but could result in an irreparable failure, that would result in the unit being out of service from 1.5 to 3 years.

The protection and control systems are also experiencing reduced reliability and causing regularly recurring forced outages on the unit. Much of the equipment is now obsolete, and no longer supported by their Original Equipment Manufacturers (OEMs). Spare parts are no longer available from the OEM and if acquired can not be guaranteed for fit or function from the third party suppliers.

The Turbine shaft seal is in poor condition due to corrosion and a badly worn sleeve resulting in repeat forced outages to replace the carbon seals.

The unit is experiencing issues with scroll case de-watering and watering-up, causing extensions to maintenance outages. The dogging beams are undersized, have been submerged for the life of the unit, and are no longer in a usable condition.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

JUSTIFICATION

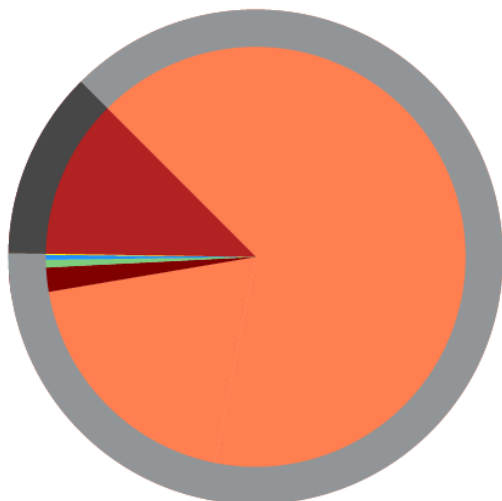
The Kettle Unit 12 assets are in poor condition with declining reliability and high potential costs of in-service failure. Overhauling the unit will mitigate the lost generation risk and its consequential financial losses with approximately a 6:1 benefit-cost ratio.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

Major failures of generation core equipment often result in damage that cannot be repaired and returned to service, resulting in extended forced outages, ranging from months to years.

Capital Investment Justification

CORPORATE VALUE FRAMEWORK



Value Measure	Value Points	% of Value
Lost Generation Risk	93,906	84.84%
Financial Risk	2,063	1.86%
Environmental Risk	653	0.59%
Safety Risk	413	0.37%
O&M Financial Benefits	89	0.08%
Total Cost	-13,567	12.26%
Total Value	83,558	
Value/\$K	6.16	

Capital Investment Justification

ANALYSIS OF ALTERNATIVES:

ECONOMIC ANALYSIS		
Discount Rate	For current corporate rates see P911 6%	

Active Option	NPV Benefits/(Costs)	CVF Score	Value/\$K
Replace Generator Stators		83,558	6.16

Other Alternatives	NPV Benefits/(Costs)	CVF Score	Value/\$K
See Other Alternatives Considered section			

INVESTMENT RISK ANALYSIS
<p>Scope:</p> <ul style="list-style-type: none"> There is a risk that work packages may be introduced after the CIJ approval adding to the scope of the project including; the design and installation of a full vibration monitoring system, which is dependent on development of corporate guidelines; and the intake gate J-seal replacement, dependent upon findings of further investigations. No contingency is included for these risks. <p>Schedule:</p> <ul style="list-style-type: none"> There is a risk that one of the other stators in the Kettle station may have a catastrophic failure that would require the stator replacement move to that unit; there is a risk the outage gets moved or delayed due to unforeseen circumstances with other generating stations or transmission issues and Manitoba Hydro would continue to carry the associated lost generation risk. No contingency is included for these risks. <p>Budget:</p> <ul style="list-style-type: none"> The value of this contract can be affected by the global demand for OEM resources and commodity pricing. The current budget reflects the best information available and includes recent OEM input. A contingency of \$400k is included in the budget for this risk. The value of the mechanical contract may vary with market conditions, Indigenous training requirements or Direct Negotiated Contract (DNC) impacts. A contingency of \$200k is included in the budget for this risk. If other major projects in the Lower Nelson River area are executing at the same time, there may be a lack of vacancy in the Kettle Camp for all the workers required to complete work. No budget contingency has been included. Other projects will be monitored and coordinated as much as possible.

Capital Investment Justification

ESTIMATED COST FLOW			
The annual projected cost flows are as follows (in thousands of dollars):			
Fiscal Year	Budget	Contributions	Net Budget
Prev. Actuals	\$0	\$0	\$0
2025/2026	\$0	\$0	\$0
2026/2027	\$0	\$0	\$0
2027/2028	\$2,586	\$0	\$2,586
2028/2029	\$7,582	\$0	\$7,582
2029/2030	\$15,210	\$0	\$15,210
2030/2031+	\$38	\$0	\$38
Total	\$25,416	\$0	\$25,416

IMPACT ON O&A COSTS
New and refurbished equipment will replace old, obsolete and equipment in poor condition, which will reduce the O&M costs required to maintain the unit. O&M costs were considered in the evaluation of all the items included in the scope. No options selected would increase the O&M requirements.

PROPOSED SCHEDULE
2030 January - Unit 12 ISD

RELATED INVESTMENTS
Kettle Unit 9 Minor Overhaul P:32920 CL23175
Kettle Unit 7 Minor Overhaul P:32912 CL 23173
Kettle Unit 11 Minor Overhaul P:32918 CL23176

OTHER ALTERNATIVES CONSIDERED
The Kettle overhaul investment has many permutations and combinations of scope items for consideration. Scope item inclusion decisions and scope item alternatives were evaluated and the combinations assessed. Due to the number of resulting investment alternatives it is not feasible to document all of them in the CIJ.

The most material scope item alternative identified was the option to refurbish the stator (new windings, re-use the core and frame), but this was discounted due to:

- The lost revenue due to the extended time the unit would be out of service (additional 7 weeks minimum) for a rewind is greater than the additional cost of a new frame and core.
- Risk to the outage duration when completing a rewind on an existing stator frame and core is unknown. Any additional repairs required to the core and frame would extend the outage and increase lost generation revenue.

Capital Investment Justification

REFERENCE DOCUMENTS
Financial Chart P32919 KT U12 OH 2019.xlsx

C55-CIJ-PROJ

**CAPITAL INVESTMENT JUSTIFICATION
FOR**

Kettle Unit 7 Minor Overhaul

Investment Type (Project)

BUDGET:	\$26,454
CONTRIBUTIONS:	\$0
NET BUDGET:	\$26,454
(values listed above are in thousands of dollars)	
CORPORATE VALUE	Value: 86,796
FRAMEWORK SCORE:	Value/\$K: 6.97

DATE PREPARED: 2019/10/04

**EC/MHEB APPROVAL MINUTE &
DATE:**

Approved by Jay Grewal
December 18, 2019

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
Midford, Lorne	VP GENERATION & WHOLESALE		VP Generation & Wholesale	2019/11/22
Turner, Hal	DIRECTOR GENERATION ASSET MANAGEMENT		Director - Generation Asset Management	2019/11/11
Kreml, John	DIRECTOR GENERATION OPERATIONS & MTCE		Director - Generation Ops & Maintenance	2019/11/07
Playford, Tom	NORTHERN GENERATION DEPARTMENT MANAGER		Lower Nelson River Operations	2019/11/07
Bishop, Gary	GEN ASSET STRATEGY & PERF DEPT MANAGER		Generation Asset Strategy and Performanc	2019/10/28
Miller, Sandy	GENERATION PROJECT MANAGEMENT DEPT MGR		Generation Project Management	2019/10/28
Austman, Jordan	PROJECT MANAGEMENT SECTION HEAD		Generation Project Management	2019/10/25
Johnson, Erin	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2019/10/25
Stephenson, Patti-Ann	STAFF OFFICER		Generation Project Management	2019/10/04
Jensen, Rob	ASSET PLANNING SUPPORT SECTION HEAD	On behalf Of Allard, Kathleen (kallard).	Generation Asset Strategy and Performanc	2019/10/04

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Generation & Wholesale	REQUESTING OPERATING/CORPORATE GROUP:	Generation & Wholesale
RESPONSIBLE DIVISION:	Generation Asset Management	REQUESTING DIVISION:	Generation Asset Management
RESPONSIBLE DEPARTMENT:	Generation Project Management	ISD: (YYYY/MM/DD)	2031/12/29
I.M. NODE NUMBER:	2.1.20.15.02.94	W.B.S. NUMBERS:	P:32912
C55 INVESTMENT CODE:	23173		
SAP PROJECT TYPE:	22 – Executive Committee	C55 INVESTMENT SUB-CATEGORY:	Single WBS
CORPORATE INVESTMENT CATEGORIES:	(Level 1) C3 / Sustainment (Level 2) CM / System Renewal		

CONTACTS			
PREPARED BY:	Stephenson, Patti-Ann STAFF OFFICER 51460	REQUESTOR:	SYLVESTRE, JORDAN (jsylvestre)
PROJECT MANAGER:	Misura, Lyle PROJECT ENGINEER 51460		

MANITOBA HYDRO
CAPITAL INVESTMENT JUSTIFICATION
Kettle Unit 7 Minor Overhaul

RECOMMENDATION

Approve a budget of \$26.5M to complete an overhaul on Unit 7 at Kettle Generating Station to extend its useful life.

SCOPE

The scope of work includes:

- Generator - replace the stator, refurbish the rotor & auxiliary system upgrades.
- Turbine - shaft seal replacement, bearing refurbishment and head cover sump piping replacement.
- Electrical Upgrades - excitation system, unit control and monitoring system (UCMS), governor system, unit protection system, unit synchronizing system, and refurbishment of the generator terminal cubicle (GTC).
- Intake gates - dogging beam replacement, sill seal replacement, riparian valve installation and hydraulic gate hose replacement.

The scope of work excludes work to the wicket gate operating system, runner, water passage, turbine/generator shaft, GSU transformers, or the dewatering header piping.

BACKGROUND

Kettle Units 7 is original to the station and has been in-service for over 45 years. Recent insulation testing indicates the unit is in poor condition.

Stators in Kettle have experienced multiple stator winding failures and reactive repairs to return the units to service. Any in-service failure will result in a 2-10 week outage to repair, but could result in an irreparable failure, that would result in the unit being out of service from 1.5 to 3 years.

The protection and control systems are also experiencing reduced reliability and causing regularly recurring forced outages on the unit. Much of the equipment is now obsolete, and no longer supported by their Original Equipment Manufacturers (OEMs). Spare parts are no longer available from the OEM and if acquired can not be guaranteed for fit or function from the third party suppliers.

The Turbine shaft seal is in poor condition due to corrosion and a badly worn sleeve resulting in repeat forced outages to replace the carbon seals.

The unit is experiencing issues with scroll case de-watering and watering-up, causing extensions to maintenance outages. The dogging beams are undersized, have been submerged for the life of the unit, and are no longer in a usable condition.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

JUSTIFICATION

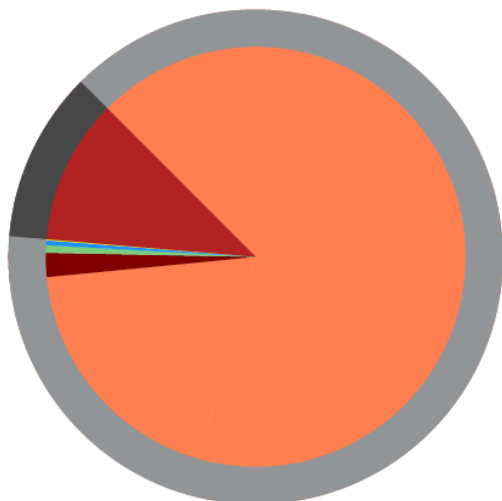
The Kettle Unit 7 assets are in poor condition with declining reliability and high potential costs of in-service failure. Overhauling the unit will mitigate the lost generation risk and its consequential financial losses with approximately a 6:1 benefit-cost ratio.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

Major failures of generation core equipment often result in damage that cannot be repaired and returned to service, resulting in extended forced outages, ranging from months to years.

Capital Investment Justification

CORPORATE VALUE FRAMEWORK



Value Measure	Value Points	% of Value
Lost Generation Risk	96,038	85.97%
Financial Risk	2,063	1.85%
Environmental Risk	653	0.58%
Safety Risk	413	0.37%
O&M Financial Benefits	89	0.08%
Total Cost	-12,460	11.15%
Total Value	86,796	
Value/\$K	6.97	

Capital Investment Justification

ANALYSIS OF ALTERNATIVES:

ECONOMIC ANALYSIS		
Discount Rate	For current corporate rates see P911 6%	

Active Option	NPV Benefits/(Costs)	CVF Score	Value/\$K
Replace Generator Stators		86,796	6.97

Other Alternatives	NPV Benefits/(Costs)	CVF Score	Value/\$K
See Other Alternatives Considered section			

INVESTMENT RISK ANALYSIS
<p>Scope:</p> <ul style="list-style-type: none"> There is a risk that work packages may be introduced after the CIJ approval adding to the scope of the project including; the design and installation of a full vibration monitoring system, which is dependent on development of corporate guidelines; and the intake gate J-seal replacement, dependent upon findings of further investigations. No contingency is included for these risks. <p>Schedule:</p> <ul style="list-style-type: none"> There is a risk that one of the other stators in the Kettle station may have a catastrophic failure that would require the stator replacement move to that unit; there is a risk the outage gets moved or delayed due to unforeseen circumstances with other generating stations or transmission issues and Manitoba Hydro would continue to carry the associated lost generation risk. No contingency is included for these risks. <p>Budget:</p> <ul style="list-style-type: none"> The value of this contract can be affected by the global demand for OEM resources and commodity pricing. The current budget reflects the best information available and includes recent OEM input. A contingency of \$400k is included in the budget for this risk. The value of the mechanical contract may vary with market conditions, Indigenous training requirements or Direct Negotiated Contract (DNC) impacts. A contingency of \$200k is included in the budget for this risk. If other major projects in the Lower Nelson River area are executing at the same time, there may be a lack of vacancy in the Kettle Camp for all the workers required to complete work. No budget contingency has been included. Other projects will be monitored and coordinated as much as possible.

Capital Investment Justification

ESTIMATED COST FLOW			
The annual projected cost flows are as follows (in thousands of dollars):			
Fiscal Year	Budget	Contributions	Net Budget
Prev. Actuals	\$0	\$0	\$0
2025/2026	\$0	\$0	\$0
2026/2027	\$0	\$0	\$0
2027/2028	\$0	\$0	\$0
2028/2029	\$0	\$0	\$0
2029/2030	\$2,699	\$0	\$2,699
2030/2031+	\$23,755	\$0	\$23,755
Total	\$26,454	\$0	\$26,454

IMPACT ON O&A COSTS

New and refurbished equipment will replace old, obsolete and equipment in poor condition, which will reduce the O&M costs required to maintain the unit.

O&M costs were considered in the evaluation of all the items included in the scope. No options selected would increase the O&M requirements.

PROPOSED SCHEDULE

Proposed ISD beyond FY2030

RELATED INVESTMENTS

Kettle Unit 9 Minor Overhaul P:32920 CL23175
Kettle Unit 11 Minor Overhaul P:32918 CL23176
Kettle Unit 12 Minor Overhaul P:32919 CL23177

OTHER ALTERNATIVES CONSIDERED

The Kettle overhaul investment has many permutations and combinations of scope items for consideration. Scope item inclusion decisions and scope item alternatives were evaluated and the combinations assessed. Due to the number of resulting investment alternatives it is not feasible to document all of them in the CIJ.

The most material scope item alternative identified was the option to refurbish the stator (new windings, re-use the core and frame), but this was discounted due to:

- The lost revenue due to the extended time the unit would be out of service (additional 7 weeks minimum) for a rewind is greater than the additional cost of a new frame and core.
- Risk to the outage duration when completing a rewind on an existing stator frame and core is unknown. Any additional repairs required to the core and frame would extend the outage and increase lost generation revenue.

Capital Investment Justification

REFERENCE DOCUMENTS

[Financial Chart P32912 KT U7 OH 2019.xlsx](#)

C55-CIJ-PROJ

**CAPITAL INVESTMENT JUSTIFICATION
FOR**

Kettle Unit 9 Minor Overhaul

Investment Type (Project)

BUDGET:	\$27,642
CONTRIBUTIONS:	\$0
NET BUDGET:	\$27,642
(values listed above are in thousands of dollars)	
CORPORATE VALUE	Value: 70,293
FRAMEWORK SCORE:	Value/\$K: 4.42

DATE PREPARED: 2019/10/04

**EC/MHEB APPROVAL MINUTE &
DATE:**

Approved by Jay Grewal
December 18, 2019

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
Midford, Lorne	VP GENERATION & WHOLESALE		VP Generation & Wholesale	2019/11/22
Turner, Hal	DIRECTOR GENERATION ASSET MANAGEMENT		Director - Generation Asset Management	2019/11/11
Kreml, John	DIRECTOR GENERATION OPERATIONS & MTCE		Director - Generation Ops & Maintenance	2019/11/07
Playford, Tom	NORTHERN GENERATION DEPARTMENT MANAGER		Lower Nelson River Operations	2019/11/07
Bishop, Gary	GEN ASSET STRATEGY & PERF DEPT MANAGER		Generation Asset Strategy and Performanc	2019/10/28
Miller, Sandy	GENERATION PROJECT MANAGEMENT DEPT MGR		Generation Project Management	2019/10/28
Austman, Jordan	PROJECT MANAGEMENT SECTION HEAD		Generation Project Management	2019/10/25
Johnson, Erin	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2019/10/25
Stephenson, Patti-Ann	STAFF OFFICER		Generation Project Management	2019/10/04
Jensen, Rob	ASSET PLANNING SUPPORT SECTION HEAD	On behalf Of Allard, Kathleen (kallard).	Generation Asset Strategy and Performanc	2019/10/04

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Generation & Wholesale	REQUESTING OPERATING/CORPORATE GROUP:	Generation & Wholesale
RESPONSIBLE DIVISION:	Generation Asset Management	REQUESTING DIVISION:	Generation Asset Management
RESPONSIBLE DEPARTMENT:	Generation Project Management	ISD: (YYYY/MM/DD)	2028/12/31
I.M. NODE NUMBER:	2.1.20.15.02.95	W.B.S. NUMBERS:	P:32920
C55 INVESTMENT CODE:	23175		
SAP PROJECT TYPE:	22 – Executive Committee	C55 INVESTMENT SUB-CATEGORY:	Single WBS
CORPORATE INVESTMENT CATEGORIES:	(Level 1) C3 / Sustainment (Level 2) CM / System Renewal		

CONTACTS			
PREPARED BY:	Edwards, Alaina PROJECT CONTROL & REPORTING OFFICER 51460	REQUESTOR:	SYLVESTRE, JORDAN (jsylvestre)
PROJECT MANAGER:	Misura, Lyle PROJECT ENGINEER 51460		

MANITOBA HYDRO
CAPITAL INVESTMENT JUSTIFICATION
Kettle Unit 9 Minor Overhaul

RECOMMENDATION

Approve a budget of \$27.6 million to complete an overhaul on Unit 9 at Kettle Generating Station to extend its useful life.

SCOPE

The scope of work includes:

- Generator - replace the stator, refurbish the rotor & auxiliary system upgrades.
- Turbine - shaft seal replacement, bearing refurbishment and head cover sump piping replacement.
- Electrical Upgrades - excitation system, unit control and monitoring system (UCMS), governor system, unit protection system, unit synchronizing system, and refurbishment of the generator terminal cubicle (GTC).
- Intake gates - dogging beam replacement, sill seal replacement, riparian valve installation and hydraulic gate hose replacement.

The scope of work excludes work to the wicket gate operating system, runner, water passage, turbine/generator shaft, GSU transformers, or the dewatering header piping.

BACKGROUND

Kettle Units 9 is original to the station and has been in-service for over 45 years. Recent insulation testing indicates the unit is in poor condition.

Stators in Kettle have experienced multiple stator winding failures and reactive repairs to return the units to service. Any in-service failure will result in a 2-10 week outage to repair, but could result in an irreparable failure, that would result in the unit being out of service from 1.5 to 3 years.

The protection and control systems are also experiencing reduced reliability and causing regularly recurring forced outages on the unit. Much of the equipment is now obsolete, and no longer supported by their Original Equipment Manufacturers (OEMs). Spare parts are no longer available from the OEM and if acquired cannot be guaranteed for fit or function from the third party suppliers.

The Turbine shaft seal is in poor condition due to corrosion and a badly worn sleeve resulting in repeat forced outages to replace the carbon seals.

The unit is experiencing issues with scroll case de-watering and watering-up, causing extensions to maintenance outages. The dogging beams are undersized, have been submerged for the life of the unit, and are no longer in a usable condition.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

JUSTIFICATION

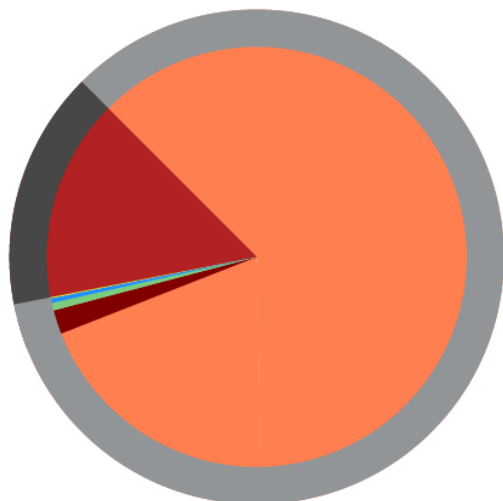
The Kettle Unit 9 assets are in poor condition with declining reliability and high potential costs of in-service failure. Overhauling the unit will mitigate the lost generation risk and its consequential financial losses with approximately a 4:1 benefit-cost ratio.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

Major failures of generation core equipment often result in damage that cannot be repaired and returned to service, resulting in extended forced outages, ranging from months to years.

Capital Investment Justification

CORPORATE VALUE FRAMEWORK



Value Measure	Value Points	% of Value
Lost Generation Risk	83,244	81.56%
Financial Risk	1,882	1.84%
Environmental Risk	596	0.58%
Safety Risk	376	0.37%
O&M Financial Benefits	83	0.08%
Total Cost	-15,888	15.57%
Total Value	70,293	
Value/\$K	4.42	

Capital Investment Justification

ANALYSIS OF ALTERNATIVES:

ECONOMIC ANALYSIS		
Discount Rate	For current corporate rates see P911 6%	

Active Option	NPV Benefits/(Costs)	CVF Score	Value/\$K
Replace Generator Stators		70,293	4.42

Other Alternatives	NPV Benefits/(Costs)	CVF Score	Value/\$K
See Other Alternatives Considered section			

INVESTMENT RISK ANALYSIS
<p>Scope:</p> <ul style="list-style-type: none"> There is a risk that work packages may be introduced after the CIJ approval adding to the scope of the project including; the design and installation of a full vibration monitoring system, which is dependent on development of corporate guidelines; and the intake gate J-seal replacement, dependent upon findings of further investigations. No contingency is included for these risks. <p>Schedule:</p> <ul style="list-style-type: none"> There is a risk that one of the other stators in the Kettle station may have a catastrophic failure that would require the stator replacement move to that unit; there is a risk the outage gets moved or delayed due to unforeseen circumstances with other generating stations or transmission issues and Manitoba Hydro would continue to carry the associated lost generation risk. No contingency is included for these risks. <p>Budget:</p> <ul style="list-style-type: none"> The value of this contract can be affected by the global demand for OEM resources and commodity pricing. The current budget reflects the best information available and includes recent OEM input. A contingency of \$400k is included in the budget for this risk. The value of the mechanical contract may vary with market conditions, Indigenous training requirements or Direct Negotiated Contract (DNC) impacts. A contingency of \$200k is included in the budget for this risk. If other major projects in the Lower Nelson River area are executing at the same time, there may be a lack of vacancy in the Kettle Camp for all the workers required to complete work. No budget contingency has been included. Other projects will be monitored and coordinated as much as possible.

Capital Investment Justification

ESTIMATED COST FLOW			
The annual projected cost flows are as follows (in thousands of dollars):			
Fiscal Year	Budget	Contributions	Net Budget
Prev. Actuals	\$0	\$0	\$0
2025/2026	\$849	\$0	\$849
2026/2027	\$3,787	\$0	\$3,787
2027/2028	\$8,352	\$0	\$8,352
2028/2029	\$14,459	\$0	\$14,459
2029/2030	\$196	\$0	\$196
2030/2031	\$0	\$0	\$0
2031/2032+	\$0	\$0	\$0
Total	\$27,642	\$0	\$27,642

IMPACT ON O&A COSTS
New and refurbished equipment will replace old, obsolete and equipment in poor condition, which will reduce the O&M costs required to maintain the unit. O&M costs were considered in the evaluation of all the items included in the scope. No options selected would increase the O&M requirements.

PROPOSED SCHEDULE
2029 January – Unit 9 ISD

RELATED INVESTMENTS
Kettle Unit 7 Minor Overhaul P:32912 CL 23173
Kettle Unit 11 Minor Overhaul P:32918 CL23176
Kettle Unit 12 Minor Overhaul P:32919 CL23177

OTHER ALTERNATIVES CONSIDERED
The Kettle overhaul investment has many permutations and combinations of scope items for consideration. Scope item inclusion decisions and scope item alternatives were evaluated and the combinations assessed. Due to the number of resulting investment alternatives it is not feasible to document all of them in the CIJ.

The most material scope item alternative identified was the option to refurbish the stator (new windings, re-use the core and frame), but this was discounted due to:

- The lost revenue due to the extended time the unit would be out of service (additional 7 weeks minimum) for a rewind is greater than the additional cost of a new frame and core.
- Risk to the outage duration when completing a rewind on an existing stator frame and core is unknown. Any additional repairs required to the core and frame would extend the outage and increase lost generation revenue.

Capital Investment Justification

REFERENCE DOCUMENTS

[Financial Chart P32920 KT U9 OH 2019.xlsx](#)

C55-CIJ-PROJ

**CAPITAL INVESTMENT JUSTIFICATION
FOR**

Kettle Unit 6 Minor Overhaul

Investment Type (Project)

BUDGET:	\$22,816
CONTRIBUTIONS:	\$0
NET BUDGET:	\$22,816
(values listed above are in thousands of dollars)	
CORPORATE VALUE	Value: 114,334
FRAMEWORK SCORE:	Value/\$K: 6.44

DATE PREPARED: 2019/09/17

**EC/MHEB APPROVAL MINUTE &
DATE:**

Approved at CAMEC
December 18, 2019

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
Midford, Lorne	VP GENERATION & WHOLESALE		VP Generation & Wholesale	2019/11/22
Turner, Hal	DIRECTOR GENERATION ASSET MANAGEMENT		Director - Generation Asset Management	2019/11/11
Kreml, John	DIRECTOR GENERATION OPERATIONS & MTCE		Director - Generation Ops & Maintenance	2019/11/07
Playford, Tom	NORTHERN GENERATION DEPARTMENT MANAGER		Lower Nelson River Operations	2019/11/07
Bishop, Gary	GEN ASSET STRATEGY & PERF DEPT MANAGER		Generation Asset Strategy and Performanc	2019/10/28
Miller, Sandy	GENERATION PROJECT MANAGEMENT DEPT MGR		Generation Project Management	2019/10/28
Austman, Jordan	PROJECT MANAGEMENT SECTION HEAD		Generation Project Management	2019/10/25
Johnson, Erin	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2019/10/25
Edwards, Alaina	PROJECT CONTROL & REPORTING OFFICER		Generation Project Management	2019/09/17
Allard, Kathleen	PORTFOLIO PLANNER		Generation Asset Strategy and Performanc	2019/09/17

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Generation & Wholesale	REQUESTING OPERATING/CORPORATE GROUP:	Generation & Wholesale
RESPONSIBLE DIVISION:	Generation Asset Management	REQUESTING DIVISION:	Generation Asset Management
RESPONSIBLE DEPARTMENT:	Generation Project Management	ISD: (YYYY/MM/DD)	2024/03/31
I.M. NODE NUMBER:	2.1.20.15.02.85	W.B.S. NUMBERS:	P:30760
C55 INVESTMENT CODE:	21203		
SAP PROJECT TYPE:	23- BOC – Corporate Asset Management Executive Committee	C55 INVESTMENT SUB-CATEGORY:	Single WBS
CORPORATE INVESTMENT CATEGORIES:	(Level 1) C3 / Sustainment (Level 2) CM / System Renewal		

CONTACTS			
PREPARED BY:	Edwards, Alaina STAFF OFFICER 51460	REQUESTOR:	SYLVESTRE, JORDAN (jsylvestre)
PROJECT MANAGER:	Misura, Lyle PROJECT ENGINEER 51460		

MANITOBA HYDRO
CAPITAL INVESTMENT JUSTIFICATION
Kettle Unit 6 Minor Overhaul

RECOMMENDATION

Approve a budget of \$22.8M to complete an overhaul on Unit 6 at Kettle Generating Station to extend its useful life.

SCOPE

The scope of work includes:

- Generator - replace the stator, refurbish the rotor & auxiliary system upgrades.
- Turbine - shaft seal replacement, bearing refurbishment and head cover sump piping replacement.
- Electrical Upgrades - excitation system, unit control and monitoring system (UCMS), governor system, unit protection system, unit synchronizing system, and refurbishment of the generator terminal cubicle (GTC).
- Intake gates - dogging beam replacement, sill seal replacement, riparian valve installation and hydraulic gate hose replacement.

The scope of work excludes work to the wicket gate operating system, runner, water passage, turbine/generator shaft, GSU transformers, or the dewatering header piping.

BACKGROUND

Kettle Units 6 is original to the station and has been in-service for over 45 years. Recent insulation testing indicates the unit is in poor condition, with major component condition indices as low as 3.46 out of 10.

Stators in Kettle have experienced multiple stator winding failures and reactive repairs to return the units to service. Any in-service failure will result in a 2-10 week outage to repair, but could result in an irreparable failure, that would result in the unit being out of service from 1.5 to 3 years.

The protection and control systems are also experiencing reduced reliability and causing regularly recurring forced outages on the unit. Much of the equipment is now obsolete, and no longer supported by their Original Equipment Manufacturers (OEMs). Spare parts are no longer available from the OEM and if acquired cannot be guaranteed for fit or function from the third party suppliers.

The Turbine shaft seal is in poor condition due to corrosion and a badly worn sleeve resulting in repeat forced outages to replace the carbon seals.

The unit is experiencing issues with scroll case de-watering and watering-up, causing extensions to maintenance outages. The dogging beams are undersized, have been submerged for the life of the unit, and are no longer in a usable condition.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

JUSTIFICATION

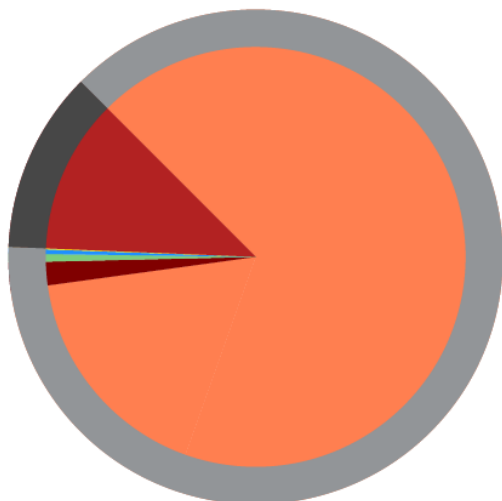
The Kettle Unit 6 assets are in poor condition with declining reliability and high potential costs of in-service failure. Overhauling the unit will mitigate the lost generation risk and its consequential financial losses with approximately a 6:1 benefit-cost ratio.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

Major failures of generation core equipment often result in damage that cannot be repaired and returned to service, resulting in extended forced outages, ranging from months to years.

Capital Investment Justification

CORPORATE VALUE FRAMEWORK



Value Measure	Value Points	% of Value
Lost Generation Risk	127,868	85.33%
Financial Risk	2,710	1.81%
Environmental Risk	858	0.57%
Safety Risk	542	0.36%
O&M Financial Benefits	112	0.07%
Total Cost	-17,757	11.85%
Total Value	114,334	
Value/\$K	6.44	

Capital Investment Justification

ANALYSIS OF ALTERNATIVES:

ECONOMIC ANALYSIS		
Discount Rate	For current corporate rates see P911 6%	

Active Option	NPV Benefits/(Costs)	CVF Score	Value/\$K
Replace Generator Stators		114,334	6.44

Other Alternatives	NPV Benefits/(Costs)	CVF Score	Value/\$K
See Other Alternatives Considered section			

INVESTMENT RISK ANALYSIS

Scope:

- There is a risk that work packages may be introduced after the CIJ approval adding to the scope of the project including; the design and installation of a full vibration monitoring system, which is dependent on development of corporate guidelines; and the intake gate J-seal replacement, dependent upon findings of further investigations. No contingency is included for these risks.

Schedule:

- There is a risk that one of the other stators in the Kettle station may have a catastrophic failure that would require the stator replacement move to that unit; there is a risk the outage gets moved or delayed due to unforeseen circumstances with other generating stations or transmission issues and Manitoba Hydro would continue to carry the associated lost generation risk. No contingency is included for these risks.

Budget:

- The value of this contract can be affected by the global demand for OEM resources and commodity pricing. The current budget reflects the best information available and includes recent OEM input. A contingency of \$400k is included in the budget for this risk.
- The value of the mechanical contract may vary with market conditions, Indigenous training requirements or Direct Negotiated Contract (DNC) impacts. A contingency of \$200k is included in the budget for this risk.
- If other major projects in the Lower Nelson River area are executing at the same time, there may be a lack of vacancy in the Kettle Camp for all the workers required to complete work. No budget contingency has been included. Other projects will be monitored and coordinated as much as possible.

Capital Investment Justification

ESTIMATED COST FLOW			
The annual projected cost flows are as follows (in thousands of dollars):			
Fiscal Year	Budget	Contributions	Net Budget
Prev. Actuals	\$0	\$0	\$0
2021/2022	\$2,553	\$0	\$2,553
2022/2023	\$6,226	\$0	\$6,226
2023/2024	\$13,996	\$0	\$13,996
2024/2025	\$41	\$0	\$41
2025/2026	\$0	\$0	\$0
2026/2027+	\$0	\$0	\$0
Total	\$22,816	\$0	\$22,816

IMPACT ON O&A COSTS
New and refurbished equipment will replace old, obsolete and equipment in poor condition, which will reduce the operating costs required to maintain Unit 6. Operating costs were considered in the evaluation of all the items included in the scope. No options selected would increase the operating requirements.

PROPOSED SCHEDULE
2020 April – Award Stator Contract
2023 February to May – Build new stator, frame and core
2023 July to 2024 January – Outage to Replace stator and complete associated work
2024 January – Unit 6 ISD

RELATED INVESTMENTS
Kettle Unit 5 Minor Overhaul P:30758 CL 13318
Kettle Unit 10 Minor Overhaul P:30762 CL 21204
Kettle Unit 8 Minor Overhaul P:32909 CL 23174

OTHER ALTERNATIVES CONSIDERED
The Kettle Unit 6 overhaul investment has many permutations and combinations of scope items for consideration. Scope item inclusion decisions and scope item alternatives were evaluated, and the combinations assessed. Due to the number of resulting investment alternatives it is not feasible to document all of them in the CIJ.

The most material scope item alternative identified was the option to refurbish the stator (new windings, re-use the core and frame), but this was discounted due to:

- The lost revenue due to the extended time the unit would be out of service (additional 7 weeks minimum) for a rewind is greater than the additional cost of a new frame and core.
- Risk to the outage duration when completing a rewind on an existing stator frame and core is unknown. Any additional repairs required to the core and frame would extend the outage and increase lost generation revenue.

Capital Investment Justification

REFERENCE DOCUMENTS
Financial Chart P30760 KT U6 OH 2019.xlsx

C55-CIC

**CAPITAL INVESTMENT CONCEPT
FOR**

MCARTHUR FALLS EXCITATION SYSTEM UPGRADE

Investment Type (Project)

SCOPE DEVELOPMENT FUNDS:	\$68
CONCEPT ESTIMATE (incl. Scope Development):	\$7,537
CONTRIBUTIONS:	\$0
NET CONCEPT ESTIMATE (incl. Scope Development):	\$7,537
(values listed above are in thousands of dollars)	
CORPORATE VALUE	Value: 144,464
FRAMEWORK SCORE :	Value/\$K: 23.51

DATE PREPARED: 2018/01/09

**EC/MHEB APPROVAL MINUTE &
DATE:**

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
BISHOP, GARY	GEN ASSET STRATEGY & PERF DEPT MANAGER		Generation Asset Strategy and Performanc	2018/01/18
BORTOLUZZI, LINDSEY	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2018/01/18
BLACK, KRISTIN	ASSET INVESTMENT COORDINATOR		Generation Asset Strategy and Performanc	2018/01/09
ALLARD, KATHLEEN	ASSET INVESTMENT PLANNING SECTION HEAD		Generation Asset Strategy and Performanc	2018/01/09

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Generation & Wholesale	REQUESTING OPERATING/CORPORATE GROUP:	Generation & Wholesale
RESPONSIBLE DIVISION:	Generation Asset Management	REQUESTING DIVISION:	Generation South
RESPONSIBLE DEPARTMENT:	Director - Generation Asset Management	ISD: (YYYY/MM/DD)	
I.M. NODE NUMBER:	2.1.20.15.02.35	W.B.S. NUMBERs:	P:14367
C55 INVESTMENT CODE:	2951		
SAP PROJECT TYPE:	24 - BOC-VP & Management	C55 INVESTMENT SUB-CATEGORY:	Single WBS
CORPORATE INVESTMENT CATEGORIES:	(Level 1) C3 / Sustainment (Level 2) CM / System Renewal		

CONTACTS			
PREPARED BY:	BLACK, KRISTIN ASSET INVESTMENT COORDINATOR 51455	REQUESTOR:	Jordan Sylvester
PROJECT MANAGER:	MILLER, SANDY GENERATION PROJECT MANAGEMENT DEPT MGR 51460		

MANITOBA HYDRO
CAPITAL INVESTMENT CONCEPT
MCARTHUR FALLS EXCITATION SYSTEM UPGRADE

RECOMMENDATION

Approve scope development funding for the replacement of the excitation systems for Units 1-8 at McArthur Falls Generating Station.

SCOPE

The scope development phase will include:

- Detailed investment evaluation within the Corporate Value Framework including identification of all feasible alternative solutions;
- Preparation of a Concept Design Report;
- Preparation of a Project Plan including detailed estimate of scope, budget and schedule for each alternative, project risk mitigation and stakeholder engagement plans; and
- Preparation of the Capital Investment Justification (CIJ).

BACKGROUND

The exciters are original to the station and have been in operation for over 60 years. They have well exceeded their life expectancy and are experiencing failures on a regular basis. The existing equipment is no longer serviceable and procurement of spare parts is not possible since original equipment manufacturers no longer exist. If this equipment is not replaced, the excitation system will fail beyond repair and the generator will be forced out of service.

These exciters should be replaced with new Digital Static Excitation Systems.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

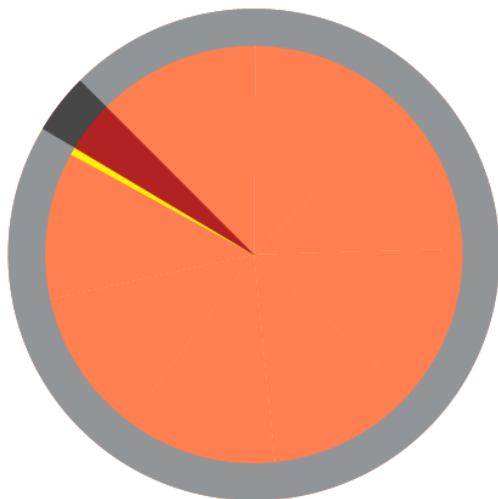
JUSTIFICATION

Original excitation systems on the Winnipeg River have a frequent failure rate which has negative effects to export revenue.

NERC Standard MOD-012-0 and MRO Generator Testing Guidelines Standard requires the generator owner to verify and validate control system models. McArthur Falls will not meet these standards due to intermittent operation and will become non-compliant.

Capital Investment Concept

CORPORATE VALUE FRAMEWORK



Value Measure	Value Points	% of Value
Lost Generation Risk	149,720	95.49%
O&M Financial Benefits	911	0.58%
Environmental Risk	0	0%
Safety Risk	0	0%
O&M Costs	-23	0.01%
Total Cost	-6,144	3.92%
Total Value	144,464	
Value/\$K	23.51	

Capital Investment Concept

OTHER ALTERNATIVES CONSIDERED

No other alternative were identified during the preliminary evaluation. Alternatives will be developed and evaluated within the concept design report.

It is recommended to consider retaining the same manufacturer within the powerhouse to reduce training and spares costs over the lifetime of the equipment.

INVESTMENT RISK ANALYSIS

There is a small risk that the preliminary project planning and concept design study will not reveal value to proceed with the project. If this occurs, project costs incurred will need to be expensed.

ESTIMATED COST FLOW

The annual projected cost flows are as follows (in thousands of dollars):

Fiscal Year	Scope Development Funds	Concept Estimate (Net of Contrib.)	Total Estimated Investment
Prev. Actuals	\$0	\$0	\$0
2018/2019	\$68	\$68	\$68
2019/2020	\$0	\$2,576	\$2,576
2020/2021	\$0	\$3,389	\$3,389
2021/2022	\$0	\$853	\$853
2022/2023	\$0	\$462	\$462
2023/2024+	\$0	\$190	\$190
Total	\$68	\$7,537	\$7,537

Capital Investment Concept

IMPACT ON O&A COSTS

It is anticipated that there will be small additional O&M costs required for operator interface; however, there is a significant expected reduction in O&M due to improvement of reliability of new equipment.

RELATED INVESTMENTS

N/A

REFERENCE DOCUMENTS

[McArthur Falls Excitation Upgrade CPJ Add 1.docx](#)

[MFGS HISTORICAL EXCITER COSTS.xlsx](#)

C55-CIC-AD

**CAPITAL INVESTMENT CONCEPT ADDENDUM
FOR**

**McArthur Falls Electrical Components Replacement/Refurbishment
Investment Type (Project)
Addendum Number 1**

	<u>PREVIOUSLY APPROVED</u>	<u>REVISED</u>	<u>INCREASE / (DECREASE)</u>
SCOPE DEVELOPMENT:	\$68	\$222	\$154
CONCEPT ESTIMATE (incl. Scope Development):	\$7,538	\$30,962	\$23,424
CONTRIBUTIONS:	\$0	\$0	\$0
NET CONCEPT ESTIMATE (incl. Scope Development):	\$7,538	\$30,962	\$23,424
(values listed above are in thousands of dollars)			
CORPORATE VALUE		Value: 144,464	Value: 101,160
FRAMEWORK SCORE :		Value/\$K: 23.51	Value/\$K: 4.12

DATE PREPARED: 2019/04/16

**EC/MHEB APPROVAL MINUTE &
DATE:**

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
TURNER, HAL	DIRECTOR GENERATION ASSET MANAGEMENT		Director - Generation Asset Management	2019/05/09
Kreml, John	DIRECTOR GENERATION OPERATIONS & MTCE		Director - Generation Ops & Maintenance	2019/05/07
FORTNEY, BRIAN	EASTERN GENERATION DEPARTMENT MANAGER		Pointe du Bois Operations-Wpg River	2019/05/06
BISHOP, GARY	GEN ASSET STRATEGY & PERF DEPT MANAGER		Generation Asset Strategy and Performanc	2019/05/04
PAWLUK, JAMES	PROJECT MANAGEMENT SECTION HEAD	On behalf Of MILLER, SANDY (sgmiller).	Generation Project Management	2019/05/03
ORELLANA, CRISTIAN	PROJECT MANAGEMENT SECTION HEAD		Generation Project Management	2019/05/03
Johnson, Erin	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2019/05/03
EDWARDS, ALAINA	PROJECT CONTROL & REPORTING OFFICER		Generation Project Management	2019/04/16
ALLARD, KATHLEEN	PORTFOLIO PLANNER		Generation Asset Strategy and Performanc	2019/04/16

ADDENDUM NUMBER	DATE	REVISION (Summary of change)

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Generation & Wholesale	REQUESTING OPERATING/CORPORATE GROUP:	Generation & Wholesale
RESPONSIBLE DIVISION:	Generation Asset Management	REQUESTING DIVISION:	Generation Operations and Maintenance
RESPONSIBLE DEPARTMENT:	Generation Project Management	ISD: (YYYY/MM/DD)	2019/12/31
I.M. NODE NUMBER:	2.1.20.15.02.35	W.B.S. NUMBERS:	P:14367, P:30709
C55 INVESTMENT CODE:	2951		
SAP PROJECT TYPE:	23 - BOC-Corporate Asset Management Executive Council	C55 INVESTMENT SUB-CATEGORY:	Shell
CORPORATE INVESTMENT CATEGORIZATION:	(Level 1) C3 / Sustainment (Level 2) CM / System Renewal		

CONTACTS

PREPARED BY:	KJARTANSON, DERRICK STAFF OFFICER 51460	REQUESTOR:	SYLVESTRE, JORDAN (jsylvestre)
PROJECT MANAGER:	NORBERG, JANELLE PROFESSIONAL ENGINEER 51460		

MANITOBA HYDRO
CAPITAL INVESTMENT CONCEPT ADDENDUM
McArthur Falls Electrical Components Replacement/Refurbishment

RECOMMENDATION

Increase the budget by \$154k to \$222k for the scope development stage to include consideration of additional electrical upgrades to minimize the upcoming outage requirements for units 1 to 8 at McArthur Falls Generation Station.

SCOPE

Scope development expanded to consider addition of the following major components:

- Unit Switchgear;
- Unit Control and Protection;
- Generator Rotor Field Poles;
- Generator Neutral Grounding;
- Direct Current (DC) Zoning 250 volt; and
- Generator Step-Up (GSU) Transformers.

Original components:

- Excitation System.

BACKGROUND

Each of the major components identified in the extended scope for consideration is approaching the end of useful life measuring condition indexing scores as low as 4/10. There have been observed operational, functional and mechanical failure indications including failures to operate, excessive loading, leaking and fatigue cracking. Much of the electrical equipment in question is also now obsolete, meaning that parts are no longer available or supported by Original Equipment Manufacturer (OEM). The McArthur Falls Generating Station is experiencing repeated short term forced outages and extended planned outages on various units due to the current condition and hidden failures of these major components. Generation is also at risk of lengthy forced outages if an unplanned replacement is required due to the long lead time for design and delivery in many cases. Due to the nature of the equipment there are inherent safety risks with operating high energy equipment that is undersized, not meeting current design standards, or malfunctioning.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

JUSTIFICATION

Budget Increases - The Scope Development has been expanded to realize design and installation efficiencies by combining multiple electrical components and allow for one time interfacing and troubleshooting.

Lost Generation – Units are frequently on forced outages due to electrical failures that are extended due to the obsolete nature of the system and lack of availability for replacement parts. Replacement of many of these components is necessary for restoring reliability at McArthur Falls.

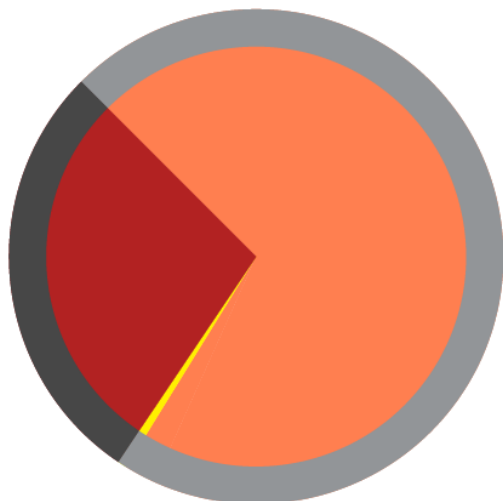
Additionally, McArthur Falls is a day-shift only station. Upgrading the electrical systems is necessary to keep the

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

station in compliance and have the proper functionality to operate and communicate remotely with Great Falls and the Station Control Centre (SCC).

Capital Investment Concept Addendum

CORPORATE VALUE FRAMEWORK (REVISED)



Value Measure	Value Points	% of Value
Lost Generation Risk	124,663	82.94%
O&M Financial Benefits	1,071	0.71%
Environmental Risk	0	0%
Safety Risk	0	0%
O&M Costs	-29	0.02%
Total Cost	-24,546	16.33%
Total Value	101,160	
Value/\$K	4.12	

Capital Investment Concept Addendum

OTHER ALTERNATIVES CONSIDERED

No additional alternatives have been identified as a result of this addendum.

INVESTMENT RISK ANALYSIS

No additional risk has been identified as a result of this addendum.

MANITOBA HYDRO
CAPITAL INVESTMENT CONCEPT ADDENDUM
McArthur Falls Electrical Components Replacement/Refurbishment

ESTIMATED COST FLOW									
The annual projected cost flows are as follows (in thousands of dollars):									
	PREVIOUSLY APPROVED			PROPOSED			INCREASE/ (DECREASE)		
Fiscal Year	Scope Development Funds	Concept Estimate	Total Estimated Investment (Net of Contrib.)	Scope Development Funds	Concept Estimate	Total Estimated Investment (Net of Contrib.)	Scope Development Funds	Concept Estimate	Total Estimated Investment (Net of Contrib.)
2018/2019	\$68	\$68	\$68	\$180	\$180	\$180	\$112	\$112	\$112
2019/2020	\$0	\$2,576	\$2,576	\$42	\$42	\$42	\$42	(\$2,534)	(\$2,534)
2020/2021	\$0	\$3,389	\$3,389	\$0	\$340	\$340	\$0	(\$3,049)	(\$3,049)
2021/2022	\$0	\$853	\$853	\$0	\$7,600	\$7,600	\$0	\$6,747	\$6,747
2022/2023	\$0	\$462	\$462	\$0	\$7,600	\$7,600	\$0	\$7,138	\$7,138
2023/2024	\$0	\$190	\$190	\$0	\$7,600	\$7,600	\$0	\$7,410	\$7,410
2024/2025+	\$0	\$0	\$0	\$0	\$7,600	\$7,600	\$0	\$7,600	\$7,600
Total	\$68	\$7,538	\$7,538	\$222	\$30,962	\$30,962	\$154	\$23,424	\$23,424

IMPACT ON O&A COSTS
No additional O&A costs have been identified as a result of this addendum.

MANITOBA HYDRO
CAPITAL INVESTMENT CONCEPT ADDENDUM
McArthur Falls Electrical Components Replacement/Refurbishment

RELATED INVESTMENTS
N/A

REFERENCE DOCUMENTS
McArthur Falls Excitation Upgrade CPJ Add 1.docx MFGS HISTORICAL EXCITER COSTS.xlsx 2951_CIC_McARTHUR FALLS EXCITATION SYST.docx

C55-CIJ-PROJ

**CAPITAL INVESTMENT JUSTIFICATION
FOR**

McArthur Falls Electrical Components Replacement/Refurbishment

Investment Type (Project)

BUDGET:	\$24,362
CONTRIBUTIONS:	\$0
NET BUDGET:	\$24,362
(values listed above are in thousands of dollars)	
CORPORATE VALUE	Value: 199,617
FRAMEWORK SCORE:	Value/\$K: 14.71

DATE PREPARED: 2022-08-24

EC/MHEB APPROVAL MINUTE & DATE: Approved by Aurel Tess, CFO
on 9/27/2022

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
Turner, Hal	VP ASSET PLANNING & DELIVERY		VP Asset Planning & Delivery	2022-09-22
Pawluk, James	DIRECTOR ASSET MANAGEMENT		Director - Asset Management	2022-09-21
Ward, Ryan	DIRECTOR PROJECT MANAGEMENT	On behalf Of Bowen, Dave (dbowen).	Director Project Management	2022-09-09
Halayko, Krista	ASSET MGMT STRATEGY & PLANNING DEPT MGR		Asset Management Strategy & Planning	2022-09-02
Orellana, Cristian	GENERATION PROJECTS DEPARTMENT MANAGER		Generation Projects	2022-09-01
Johnson, Erin	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2022-08-31
Sage, Scott	PROJECT FINANCIAL ANALYST		Project Services	2022-08-24
Bell, Christine	PORTFOLIO ACCOUNTANT	On behalf Of Dlot, Aaron (adlot).	Asset Management Strategy & Planning	2022-08-24

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Asset Planning & Delivery	REQUESTING OPERATING/CORPORATE GROUP:	Asset Planning & Delivery
RESPONSIBLE DIVISION:	Project Management	REQUESTING DIVISION:	Asset Management
RESPONSIBLE DEPARTMENT:	Generation Projects	ISD: (YYYY/MM/DD)	2030/09/30
I.M. NODE NUMBER:	2.1.20.15.02.35	W.B.S. NUMBERS:	P:14367, P:30709
C55 INVESTMENT CODE:	2951		
SAP PROJECT TYPE:	23 - BOC-CFO	C55 INVESTMENT SUB-CATEGORY:	Shell
CORPORATE INVESTMENT CATEGORIES:	(Level 1) C3 / Sustainment (Level 2) CM / System Renewal		

CONTACTS			
PREPARED BY:	Swait, Caitlin FINANCIAL SERVICES LEAD - GEN PROJECTS 51185	REQUESTOR:	David Hildebrand, Asset Lifecycle Mgmt Dept.
PROJECT MANAGER:	Mozden, Kammy PROJECT GEOSCIENTIST 51460		

MANITOBA HYDRO
CAPITAL INVESTMENT JUSTIFICATION
McArthur Falls Electrical Components Replacement/Refurbishment

RECOMMENDATION

Approve a budget of \$24.4 million to replace electrical components in units 1 to 8 at McArthur Falls Generation Station because the condition of the existing assets is beyond the economic end-of-life.

SCOPE

The scope of work includes:

- Replacement/modernization of the eight existing rotating exciters with static excitation systems including power potential transformers (PPTs);
- Replacement of major switchgear components (breakers, potential transformers (PTs), current transformers (CTs), arresters and capacitors) on all eight units, with the addition of new grounding transformers and resistors to units 3-8 (already existing on units 1 & 2);
- Replacement of the eight existing generator protection cubicles with eight A-type generator protection cubicles;
- Purchase of one spare three-phase generator step-up (GSU) transformer and construction of one outdoor concrete storage pad.

BACKGROUND

Each of the major components identified above have reached the end of their useful life. There have been operational, functional and mechanical failure indicators including failure to operate, excessive loading, leaking and fatigue cracking.

The McArthur Falls Generating Station is experiencing repeated short term forced outages and extended planned outages on all units due to the condition of these major components. Much of the equipment and spare parts can no longer be procured and are no longer supported by their original equipment manufacturers (OEMs).

A serious failure will result in irreparable damage and a unit(s) that cannot be returned to service. Generation is at risk of a forced outage, up to 2 years, if an unplanned replacement is required due to the long lead time for components.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

JUSTIFICATION

The replacement of major components in these units is necessary for ensuring unit availability, hence, the main value measure driving the execution of this project is the mitigation of lost generation.

Lost Generation Risk

This investment will maximize the value of Units 1- 8 at the McArthur Falls Generating station by returning assets to improved availability and reliability. The work will mitigate the lost generation risk associated with an out of service unit due to failure of major components and reactive repair/replacement.

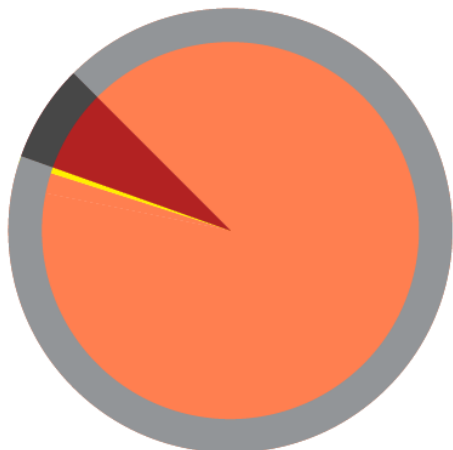
JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

O&M Financial Benefits

This work improves the unit reliability and availability by reducing the regularly occurring reactive repairs through replacement of equipment currently causing forced outages.

Capital Investment Justification

CORPORATE VALUE FRAMEWORK



Value Measure	Value Points	% of Value
Lost Generation Risk	212,317	93.61%
O&M Financial Benefits	895	0.39%
O&M Costs	-25	0.00%
Total Cost	-13,570	5.98%
Total Value	199,617	
Value/\$K	14.71	

Capital Investment Justification

ANALYSIS OF ALTERNATIVES:

ECONOMIC ANALYSIS		
Discount Rate	For current corporate rates see P911 6%	

Active Option	NPV Benefits/(Costs)	CVF Score	Value/\$K
Recommended Scope plus Spare GSU Only		199,065	149.48

Other Alternatives	NPV Benefits/(Costs)	CVF Score	Value/\$K
Recommended scope plus new GSU transformers		180,065	9.48
Recommended Scope plus No GSUs		74,510	6.17

INVESTMENT RISK ANALYSIS
<p>Contingency of \$1.7M has been included to cover scope, schedule and budget following a risk review and contingency analysis. The contingency consists of \$996K of systemic risks and \$704K of project specific risks which are broken down into the following:</p> <p>Systemic Risks:</p> <ul style="list-style-type: none"> • Systemic risks are those not unique to a particular project’s scope, attributes, or delivery strategy. These are risks all projects face as a result of uncertainties within an industry, company, culture, technology or similar over-arching characteristics. • Contingency in the amount of \$996K has been included to address systemic risks. <p>Project Specific Risks:</p> <p>Scope:</p> <ul style="list-style-type: none"> • There is a risk new cabling could exceed capacity of the existing cable trays; • There is a risk new switchgear may require adjustments during installation if it does not line up in the existing switchgear footprint; • There is the potential for additional engineering if the 6 cables connecting the generator to the switchgear are braised directly onto the windings of the stator, as a termination pad would be required for ease of connecting / disconnecting from the switchgear; • Contingency in the amount of \$209K (~\$26K per unit) has been included to address the above scope risks. The identified scope risks are considered medium probability. <p>Schedule:</p> <ul style="list-style-type: none"> • There is a risk that scheduled in-service dates slip based on internal resources available for design and procurement. • The generator has never been fully disassembled and many of the large component interface connections are largely unknown, which may result in schedule delays. • There is a risk in-service dates or unit orders may change based on outage opportunities, water conditions, and / or emergency repairs (including unforeseen failures) • Contingency applied for in the amount of \$137K has been included to address schedule risks. The identified

Capital Investment Justification

INVESTMENT RISK ANALYSIS

schedule risks are considered low probability.

Budget:

- The value of these design, fabrication and construction contracts can be affected by the global demand for OEM resources and commodity pricing. The current budget reflects the best information available and includes recent OEM input.
- Contingency in the amount of \$358K has been included to address this risk to project budget. The identified budget risks are considered low-medium probability.

ESTIMATED COST FLOW

The annual projected cost flows are as follows (in thousands of dollars):

Fiscal Year	Budget	Contributions	Net Budget
Prev. Actuals	\$235	\$0	\$235
2022/2023	\$0	\$0	\$0
2023/2024	\$3,025	\$0	\$3,025
2024/2025	\$3,920	\$0	\$3,920
2025/2026	\$2,646	\$0	\$2,646
2026/2027	\$2,680	\$0	\$2,680
2027/2028+	\$11,857	\$0	\$11,857
Total	\$24,362	\$0	\$24,362

IMPACT ON O&A COSTS

AMPS data shows that \$10,000 in O&M costs are being spent per unit (total \$80,000 as there are eight units) annually. Installing static exciters would drop the O&M costs to \$2,000 per unit annually (total savings of \$64,000 for eight units).

PROPOSED SCHEDULE

- Start Date: Year 1
- Proposed In Service Date: Year 2 (first unit)
- Proposed In Service Date: Year 3 (second unit)
- Proposed In Service Date: Year 4 (third unit)
- Proposed In Service Date: Year 5 (fourth unit)
- Proposed In Service Date: Year 6 (fifth unit)
- Proposed In Service Date: Year 7 (sixth unit)
- Proposed In Service Date: Year 8 (seventh unit)
- Proposed In Service Date: Year 9 (eighth unit)

Capital Investment Justification

RELATED INVESTMENTS

N/A

OTHER ALTERNATIVES CONSIDERED

Two alternatives were considered:

- Recommend scope plus no spare GSU transformers – the lead time to deliver a spare GSU transformer is estimated at two years and the value in having an on-site spare is far greater than the ownership cost (i.e. best value)
- Recommended scope plus new GSU transformers – the value of replacing all GSU transformers at this time is less than the alternative to procure a spare due to the condition of the existing GSUs and the subsequent remaining serviceable life

REFERENCE DOCUMENTS

[2951 CIC MCARTHUR FALLS EXCITATION SYST.docx](#)

[2951 CIC AD MF Electrical Components Repl 1.docx](#)

C55-CIJ-PROJ

**CAPITAL INVESTMENT JUSTIFICATION
FOR**

Enterprise PCB Remediation

Investment Type (Project)

BUDGET:	\$25,098
CONTRIBUTIONS:	\$0
NET BUDGET:	\$25,098
(values listed above are in thousands of dollars)	
CORPORATE VALUE	Value: 86,799
FRAMEWORK SCORE:	Value/\$K: 4.06

DATE PREPARED: 2022-02-08

**EC/MHEB APPROVAL MINUTE &
DATE:**

Approved by Jay Grewal,
President & CEO
February 24, 2022

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
Turner, Hal	VP ASSET PLANNING & DELIVERY		VP Asset Planning & Delivery	2022-02-21
Pawluk, James	DIRECTOR ASSET MANAGEMENT		Director - Asset Management	2022-02-18
Neufeld, Maria	DIRECTOR TRANSMISSION OPS & MAINTENANCE		Director - Trans Ops & Mtce	2022-02-16
Menec, Quinn	DIRECTOR GENERATION OPERATIONS & MTCE		Director - Generation Ops & Maintenance	2022-02-16
Bowen, Dave	DIRECTOR PROJECT MANAGEMENT		Director Project Management	2022-02-15
Halayko, Krista	ASSET MGMT STRATEGY & PLANNING DEPT MGR		Asset Management Strategy & Planning	2022-02-14
Orellana, Cristian	GENERATION PROJECT MANAGEMENT DEPT MGR		Generation Projects	2022-02-11
Johnson, Erin	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2022-02-09
Duch, Tamara	ASSET INVESTMENT COORDINATOR		Asset Lifecycle Management	2022-02-09
Dlot, Aaron	ASSET INVESTMENT PLANNING SECTION HEAD		Asset Management Strategy & Planning	2022-02-08

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Asset Planning & Delivery	REQUESTING OPERATING/CORPORATE GROUP:	Asset Planning & Delivery
RESPONSIBLE DIVISION:	Asset Management	REQUESTING DIVISION:	Asset Management
RESPONSIBLE DEPARTMENT:	Asset Management Strategy & Planning	ISD: (YYYY/MM/DD)	2025/03/31
I.M. NODE NUMBER:	2.1.20.15.07.15	W.B.S. NUMBERS:	P:36218, P:36037, P:36219
C55 INVESTMENT CODE:	28285		
SAP PROJECT TYPE:	24 - BOC-VP & Management	C55 INVESTMENT SUB-CATEGORY:	Shell
CORPORATE INVESTMENT CATEGORIES:	(Level 1) D1 / Regulatory Deferrals (Level 2) DC / Site Remediation		

CONTACTS			
PREPARED BY:	Duch, Tamara ASSET INVESTMENT COORDINATOR 51220	REQUESTOR:	Dave Hildebrand
PROJECT MANAGER:	Orellana, Cristian GENERATION PROJECT MANAGEMENT DEPT MGR 51460		

MANITOBA HYDRO
CAPITAL INVESTMENT JUSTIFICATION
Enterprise PCB Remediation

RECOMMENDATION

Approve a budget of \$25 million for the remediation of all remaining assets containing Polychlorinated Biphenyl (PCB) in concentration of 45 +/- 0.5 parts per million (ppm) or greater owned by Manitoba Hydro.

SCOPE

The scope of work will include:

- Identify and categorize all current Manitoba Hydro assets that potentially contain PCBs.
- Sample and analyze assets where it is cost effective and nondestructive testing is plausible.
- Implement best value remediation strategy for each asset:
 - Replace oil; or
 - Design, procure, and install replacement equipment; or
 - Remove equipment that is no longer required.
- Implement regulatory approved elimination of PCBs including the disposal of PCB containing oil or equipment.

Equipment types include, but are not limited to: capacitor potential transformers, current transformers, power transformers, station service transformers, bushings, reactors, breakers, and lighting ballasts.

Not included in scope are any assets proven to be containing PCB levels less than 45 +/- 0.5 parts per million.

BACKGROUND

PCBs are synthetic compounds that were used in dielectric fluids to cool and insulate electrical equipment because of their stable chemical properties. By the 1970s, tests proved that PCBs were harmful to the environment, land, and personal health. Because of these concerns, the government implemented federal legislation to remove PCBs from equipment from service by December 31, 2009. The PCB regulation was amended, and the deadline was extended to December 31, 2025.

To this point, Generation, Transmission and Distribution have been working independently to identify and remediate PCB containing assets. Progress of the work to date indicates a significant risk of achieving the 2025 deadline for Enterprise remediation. A coordinated effort between energy streams would realize synergies and streamline the remediation strategy; improving visibility, consistency and efficiency in the execution.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

JUSTIFICATION

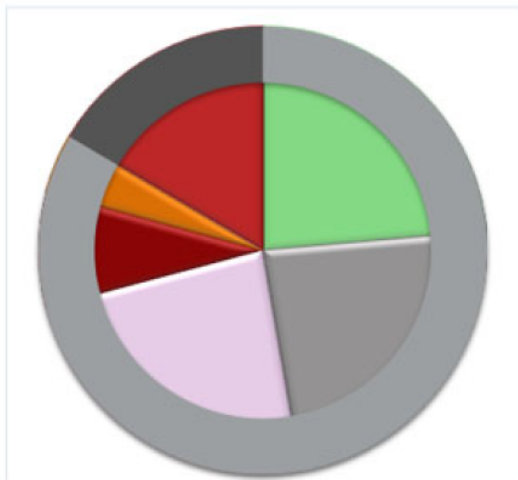
The remediation of all remaining assets containing Polychlorinated Biphenyl (PCB) in concentration of 45 +/- 0.5 parts per million (ppm) or greater owned by Manitoba Hydro is required by December 31, 2025 by federal legislation.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

In addition to the mitigation of compliance risk in carrying out this work, environmental and safety risks are also mitigated. Since PCBs are harmful to the environment and personal health, accidental release of PCBs in the environment can have detrimental long-term impacts to vegetation, wildlife and human health.

Capital Investment Justification

CORPORATE VALUE FRAMEWORK



Value Measure	Value Points	% of Value
Working Conditions Benefit	5,466	4.22%
Environmental Risk	30,620	23.63%
Compliance Risk	30,620	23.63%
Stakeholder Perception Risk	30,620	23.63%
Financial Risk	10,744	8.29%
Safety Risk	107	0.08%
Total Cost	-21,379	16.50%
Total Value	86,799	
Value/\$K	4.06	

Capital Investment Justification

ANALYSIS OF ALTERNATIVES:

ECONOMIC ANALYSIS		
Discount Rate	For current corporate rates see P911 6%	

Active Option	NPV Benefits/(Costs)	CVF Score	Value/\$K
Enterprise PCB Remediation		86,799	4.06

Other Alternatives	NPV Benefits/(Costs)	CVF Score	Value/\$K
See Other Alternatives Considered section			

INVESTMENT RISK ANALYSIS

There is a high risk to scope and budget to protect the schedule. There is a large outstanding inventory of potential PCB containing assets that require identification and classification. If PCB levels are concluded to be 45 +/- 0.5 ppm or greater, remediation will be required. The type of remediation will be dependent on the asset type, and could include oil replacement, asset replacement, or asset removal only. In all cases, compliance requires the PCB contamination (asset or oil) to be removed from service and the PCBs destroyed.

ESTIMATED COST FLOW

The annual projected cost flows are as follows (in thousands of dollars):

Fiscal Year	Budget	Contributions	Net Budget
Prev. Actuals	\$0	\$0	\$0
2021/2022	\$1,694	\$0	\$1,694
2022/2023	\$5,525	\$0	\$5,525
2023/2024	\$7,352	\$0	\$7,352
2024/2025	\$7,154	\$0	\$7,154
2025/2026	\$3,373	\$0	\$3,373
2026/2027+	\$0	\$0	\$0
Total	\$25,098	\$0	\$25,098

IMPACT ON O&A COSTS

There are no measurable impacts to the operation and administration costs as a result of this investment.

Capital Investment Justification

PROPOSED SCHEDULE

Proposed start date: December 2021

Proposed in-service: December 2025

RELATED INVESTMENTS

C55 2940 - G&W PCB Regulatory Compliance Program

C55 13879 - Sub-station PCB Bushing Elimination

C55 23255 - Day Stn Bank 3 PCB Bushings Replacement Program 19/20

C55 13898 - PCB Bushings Replace Distr Station 2024

C55 13897 - PCB Bushings Replace Trans Station 2024

C55 13896 - PCB Bushings Replace Distr Station 2023

C55 13895 - PCB Bushings Replace Trans Station 2023

C55 13894 - PCB Bushings Replace Distr Station 2022

C55 13893 - PCB Bushings Replace Trans Station 2022

C55 13892 - PCB Bushings Replace Distr Station 2021

C55 13891 - PCB Bushings Replace Trans Station 2021

C55 13890 - PCB Bushings Replace Distr Station 2020

C55 13888 - PCB Bushings Repl - Disposal of Bushings

C55 13887 - PCB Bushings Replace Distr Station 2019

C55 13886 - PCB Bushings Replace Trans Station 2019

OTHER ALTERNATIVES CONSIDERED

None

REFERENCE DOCUMENTS

[Financial Chart Enterprise PCB Remediation.xlsx](#)

C55-CIJ-PROJ

CAPITAL INVESTMENT JUSTIFICATION FOR

Jenpeg Unit 2 Overhaul

Investment Type (Project)

BUDGET:	\$53,669
CONTRIBUTIONS:	\$0
NET BUDGET:	\$53,669
(values listed above are in thousands of dollars)	
CORPORATE VALUE	Value: 322,857
FRAMEWORK SCORE:	Value/\$K: 8.35

DATE PREPARED: 2022-03-04

**EC/MHEB APPROVAL MINUTE &
DATE:**

AFC approval 6/24/2022
minute 102.7

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
Turner, Hal	VP ASSET PLANNING & DELIVERY		VP Asset Planning & Delivery	2022-03-19
Pawluk, James	DIRECTOR ASSET MANAGEMENT		Director - Asset Management	2022-03-18
Bowen, Dave	DIRECTOR PROJECT MANAGEMENT		Director Project Management	2022-03-18
Halayko, Krista	ASSET MGMT STRATEGY & PLANNING DEPT MGR		Asset Management Strategy & Planning	2022-03-14
Orellana, Cristian	GENERATION PROJECTS DEPARTMENT MANAGER		Generation Projects	2022-03-10
Johnson, Erin	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2022-03-08
Swait, Caitlin	FINANCIAL SERVICES LEAD - GEN PROJECTS		Project Services	2022-03-04
Dlot, Aaron	ASSET INVESTMENT PLANNING SECTION HEAD		Asset Management Strategy & Planning	2022-03-04

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Asset Planning & Delivery	REQUESTING OPERATING/CORPORATE GROUP:	Operations
RESPONSIBLE DIVISION:	Asset Management	REQUESTING DIVISION:	Generation Operations and Maintenance
RESPONSIBLE DEPARTMENT:	Asset Management Strategy & Planning	ISD: (YYYY/MM/DD)	2028/03/31
I.M. NODE NUMBER:	2.1.20.15.02.119	W.B.S. NUMBERS:	P:36009
C55 INVESTMENT CODE:	25079		
SAP PROJECT TYPE:	21 - BOC-Manitoba Hydro Electric Board	C55 INVESTMENT SUB-CATEGORY:	Single WBS
CORPORATE INVESTMENT CATEGORIES:	(Level 1) C3 / Sustainment (Level 2) CN / System Efficiency		

CONTACTS			
PREPARED BY:	Swait, Caitlin FINANCIAL SERVICES LEAD - GEN PROJECTS 51185	REQUESTOR:	PENNER, KEVIN (kmpenner)
PROJECT MANAGER:	Riddell, Janelle PROJECT ENGINEER 56810		

MANITOBA HYDRO CAPITAL INVESTMENT JUSTIFICATION Jenpeg Unit 2 Overhaul

RECOMMENDATION

Approve \$53.7 million for the overhaul of Unit 2 at Jenpeg Generation Station to restore reliability.

SCOPE

The scope of work includes:

- Turbine and Runner – Replace runner and turbine regulating mechanism. Refurbish the restoring rod and turbine shaft seal, inspect and refurbish all bearings as required and refurbish the wicket gates
- Oil-Water Head – Replace oil-water head
- Generator – Replace stator; rehabilitate rotor poles and replace rotor cooling water tubing, refurbish generator hatch cover, install generator brakes
- Governor – Replace controller with actuator and main distributing valve replacement
- Exciter and Power Potential Transformer (PPT) – Replace the exciter and PPT; replace fire protection and deluge, bearing alarm and trip panel, bush gear and slip ring dust collector system
- Generator Step Up Transformer (GSU) – replacement, including deluge
- Generator Circuit Breaker – Replace generator circuit breaker and auxiliary components
- Protection – Replace protection panels, transient fault recorder, DC sub panels, ground fault injection unit
- Unit Controls – Replace panels
- Piping – Refurbish and replace as required

Scope does not include:

- Refurbishment of embedments, water passage, stay vanes and struts
- Construction or operation of accommodations
- Cleaning and inspection of governor oil tanks
- Construction of storage or out-buildings

BACKGROUND

The condition score for Jenpeg Unit 2 has been assessed as “very low with a high likelihood of failure” and has been prone to frequent forced outages since 2010.

Unit 2 is equipped with the Original Equipment Manufacturer (OEM) restoring rods in their turbine shafts, which detailed engineering analysis has determined to be prone to fatigue failure. Previous restoring rod failures have resulted in extended unit outages (> 24 months) to implement repairs.

The condition of the Unit 2 turbine regulating mechanism has degraded to a point where the probability of failure has been determined to be 33 percent.

Due to the significant unit disassembly necessary to replace the restoring rod, and determination of optimal intervention dates via whole-life-cycle modeling, other value-added work has been included in the overhaul scope including:

- Runner - after 40 years of service, the runner blades are prone to fatigue cracking. According to major

BACKGROUND

turbine suppliers, this is common in Kaplan runners, signifying the end of their useful life.

- Rotor - The water cooling piping is aging and delicate. Leaks in this piping on the generator windings leads to faults and damage.
 - Optimal intervention - 2034
- Stator - The stator is 40 years old and is of original equipment manufacture. It is anticipated to be at the end of useful life but cannot be electrically tested.
 - Optimal intervention - 2028
- Electrical upgrades, protection upgrades, governor and unit controls - All of original equipment manufacture with condition scores ranging from poor to fair. All are obsolete in terms of spare parts and maintenance with known historical issues which have resulted in forced or extended outages.
 - Generator breaker optimal intervention - 2016-2025
 - Excitation system optimal intervention - 2016-2025
 - Governor optimal intervention - 2011-2021
 - Generator step-up transformer - 2024-2034
- Oil pressure systems - currently operating well above the design pressures

A Capital Investment Concept (CIC) was raised to review the options for rehabilitating Jenpeg units 1-6. Scopes of work were developed for the units and the optimizer has determined that proceeding with the overhaul of Unit 2 in fiscal year 2023, followed by the remaining units offers the greatest value to Manitoba Hydro.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

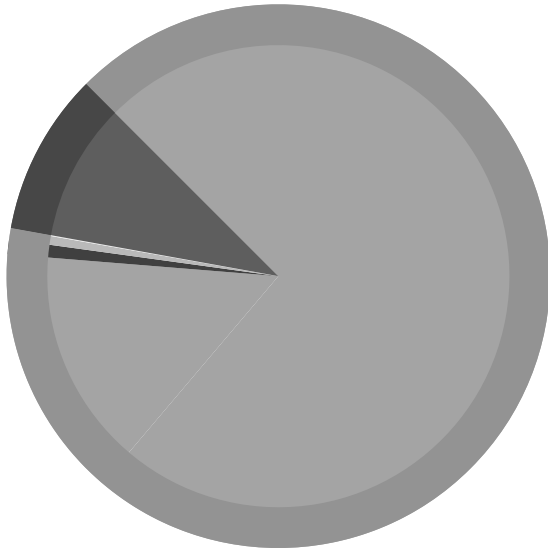
JUSTIFICATION

Jenpeg Unit 2 has numerous high consequence lost generation risks due to the condition of the runner, restoring rod and turbine regulating mechanisms and the significant repair/replace timelines. Failure of any of these components would lead to an extended outage requiring up to 48 months to replace.

This investment significantly reduces the probability of failure for these components, providing key value measures for this investment including the mitigation of lost generation, financial, and environmental risks.

This work also improves the unit's reliability and availability, by reducing the regularly occurring reactive repairs through replacement or refurbishment of equipment currently causing forced outages.

CORPORATE VALUE FRAMEWORK



Value Measure	Value Points	% of Value
Lost Generation Risk	355,314	88.79%
Financial Risk	3,548	0.89%
Environmental Risk	2,437	0.61%
O&M Financial Benefits	226	0.06%
Generation Revenue Benefit	0	0%
Safety Risk	0	0%
Total Cost	-38,667	9.66%
Total Value	322,857	
Value/\$K	8.35	

ANALYSIS OF ALTERNATIVES:

ECONOMIC ANALYSIS		
Discount Rate	For current corporate rates see P911	
	6%	

Active Option	NPV Benefits/(Costs)	CVF Score	Value/\$K
Unit Major Overhaul		322,857	8.35

Other Alternatives	NPV Benefits/(Costs)	CVF Score	Value/\$K
See Other Alternatives Considered section			

INVESTMENT RISK ANALYSIS
<p>Contingency of \$7.9M has been included to cover scope, schedule and budget following a risk review and contingency analysis. The contingency consists of \$4.6M of systemic risks and \$3.3M of project specific risks which is further broken down into the following:</p> <p>Systemic Risks:</p> <ul style="list-style-type: none"> • Systemic risks are those not unique to a particular project’s scope, attributes, or delivery strategy. They are risk all projects faces as a result of uncertainties within an industry, company, culture, technology or similar over-arching characteristics. <p>Project Specific Risks:</p> <p>Scope:</p> <ul style="list-style-type: none"> • There is a risk that scope will change during the project due to new information being discovered during unit disassembly and inspection that was previously unavailable or due to unexpected changes in component condition. The scope change process will be used to manage and justify any additional new scope items raised. • Contingency in the amount of \$1,765K has been included to address scope risks. <p>Schedule:</p> <ul style="list-style-type: none"> • Resources - There is a risk that scheduled in-service dates slip based on internal resources available for design and procurement. • Disassembly and Reassembly – Generator has never been fully disassembled and many of the large component interface connections are largely unknown and may result in schedule delays. • There is a risk that the schedule changes to accommodate a change in unit priority due to unforeseen failure(s) of other units. • Contingency in the amount of \$137K has been included to address schedule risks. <p>Budget:</p> <ul style="list-style-type: none"> • Accommodations – There are two hotels in the community of cross lake that may be available for contractor staff over the course of the project. The current investment does not account for planning, design, construction or operation of an accommodation facility such as a camp. The estimate has been constructed on the

INVESTMENT RISK ANALYSIS

assumption that accommodations are available for use. Contingency has not been allocated to address the risk of accommodations not being available for project use.

- The value of these design, fabrication and construction contracts can be affected by the global demand for OEM resources and commodity pricing. The current budget reflects the best information available and includes recent OEM input.
- Contingency in the amount of \$1,822K has been included to address this risk to project budget.

ESTIMATED COST FLOW

The annual projected cost flows are as follows (in thousands of dollars):

Fiscal Year	Budget	Contributions	Net Budget
Prev. Actuals	\$0	\$0	\$0
2021/2022	\$0	\$0	\$0
2022/2023	\$602	\$0	\$602
2023/2024	\$685	\$0	\$685
2024/2025	\$1,813	\$0	\$1,813
2025/2026	\$10,785	\$0	\$10,785
2026/2027+	\$39,783	\$0	\$39,783
Total	\$53,669	\$0	\$53,669

IMPACT ON O&A COSTS

- The investment is expected to reduce maintenance costs associated with cleaning the turbine shaft seal by replacing the carbon steel shaft seal running ring with stainless steel.
- This investment will align the service life of the oil-water head system with the rest of the maintenance on the unit.

PROPOSED SCHEDULE

April 2022 – October 2022	Project Initiation and Detailed Project Planning
June 2022 – July 2024	Internal Design and Technical Specification Preparation
February 2023 – May 2025	Major Procurements
September 2023 – October 2026	Contractor Design, Manufacturing, and Minor Procurements
May 2026 – November 2027	Construction Outage
November 2027 – Unit 2	In-service Date
December 2027 – May 2028	Project Close out

RELATED INVESTMENTS

CIC Jenpeg Units 1-6 C55 code 14116

OTHER ALTERNATIVES CONSIDERED

The following alternatives were investigated during Scope Development Stage:

- Electrical Rehab – complete electrical work excluding the stator and minor mechanical work. This alternative does not mitigate the risk associated with an extended forced outage resulting from a turbine failure. The Total Value of this alternative was the lowest.
- Generator Overhaul – electrical work including re-wind on the stator, minor mechanical work excluding runner refurbishment. The need for replacement and refurbishment on the turbine components outweighs the value of only completing overhaul work.

REFERENCE DOCUMENTS

[P36009 Jenpeg Unit 2 OH CIJ Financial Chart Nov 2021.xlsx](#)

CAPITAL INVESTMENT JUSTIFICATION FOR

Long Spruce Unit 9 Overhaul

Investment Type (Project)

BUDGET:	\$12,344
CONTRIBUTIONS:	\$0
NET BUDGET:	\$12,344
(values listed above are in thousands of dollars)	
CORPORATE VALUE	Value: 133,856
FRAMEWORK SCORE:	Value/\$K: 13.05

DATE PREPARED: 2022-08-27

EC/MHEB APPROVAL MINUTE &
DATE:

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
Turner, Hal	VP ASSET PLANNING & DELIVERY		VP Asset Planning & Delivery	2022-09-22
Pawluk, James	DIRECTOR ASSET MANAGEMENT		Director - Asset Management	2022-09-21
Ward, Ryan	DIRECTOR PROJECT MANAGEMENT		Director Project Management	2022-09-09
Halayko, Krista	ASSET MGMT STRATEGY & PLANNING DEPT MGR		Asset Management Strategy & Planning	2022-09-09
Orellana, Cristian	GENERATION PROJECTS DEPARTMENT MANAGER		Generation Projects	2022-09-08
Johnson, Erin	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2022-08-31
Sage, Scott	PROJECT FINANCIAL ANALYST		Project Services	2022-08-29
Dlot, Aaron	ASSET INVESTMENT PLANNING SECTION HEAD		Asset Management Strategy & Planning	2022-08-27

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Asset Planning & Delivery	REQUESTING OPERATING/CORPORATE GROUP:	Asset Planning & Delivery
RESPONSIBLE DIVISION:	Project Management	REQUESTING DIVISION:	Asset Management
RESPONSIBLE DEPARTMENT:	Generation Projects	ISD: (YYYY/MM/DD)	2026/06/30
I.M. NODE NUMBER:	2.1.20.15.02.48	W.B.S. NUMBERS:	P:37023
C55 INVESTMENT CODE:	26409		
SAP PROJECT TYPE:	24 - BOC-VP & Management	C55 INVESTMENT SUB-CATEGORY:	Single WBS
CORPORATE INVESTMENT CATEGORIES:	(Level 1) C3 / Sustainment (Level 2) CN / System Efficiency		

CONTACTS			
PREPARED BY:	Swait, Caitlin FINANCIAL SERVICES LEAD - GEN PROJECTS 51185	REQUESTOR:	Dave Hildebrand, Asset Lifecycle Mgmt
PROJECT MANAGER:	Wallace, Heather PROJECTS ENGINEER 51460		

MANITOBA HYDRO

CAPITAL INVESTMENT JUSTIFICATION

Long Spruce Unit 9 Overhaul

RECOMMENDATION

Approve a budget of \$12.3M for the execution of an overhaul of Unit 9 at Long Spruce Generating Station to extend its useful life.

SCOPE

The scope of work includes:

- Mechanical Upgrades: Bearing refurbishment, hazardous material abatement, rotor re-shrink and restoration of stator circularity.
- Electrical Upgrades: Governor upgrade, rotor pole re-insulation, exciter & excitation transformer replacement, generator circuit breaker replacement, and Unit Control Monitoring System (UCMS) upgrades.

The scope of work excludes Generator Step-Up (GSU) transformers, stator replacement, generator protection, turbine regulating mechanism overhaul and re-running.

BACKGROUND

Long Spruce Unit 9 has been in-service for approximately 42 years, with a generating capacity of 98 MW. Due to some known deficiencies, outlined in further detail below, scope development was approved. The scope development phase assessed these issues and investment alternatives were crafted for evaluation in the Portfolio.

Current condition assessment information and historical JobTrac requests were used to identify the components under consideration for scope.

The following components and their current known conditions are as follows:

Rotor: Fretting corrosion has been identified at the rotor spider to rim ledge as well as several cracks at the torque blocks. The rotor rim floats due to loss of shrink; an interference fit between the rim and rotor spider. A floating rim can cause fretting fatigue damage of the rotor rim shelf and may ultimately lead to the need for costly rotor disassembly and repairs or in the worst case, catastrophic failure of the rotor.

Stator: Replacement was reviewed using a whole-life cost model analysis and portfolio optimization. Replacement is not recommended at this time. Stator circularity will be reviewed and addressed based on condition during the overhaul.

Exciters: A cooling modification was performed on the rotor in the early 2000s, impacting the power factor of these units. Unfortunately, the impact to some auxiliary equipment was not taken into consideration and the excitation transformers are now underrated. To mitigate overheating issues, temporary fans have been plugged into the wall on a permanent basis and are run for a majority of the year. Without this, the transformers would trip on a high temperature alarm.

In addition, there currently are no spare field breakers for these exciters, the power supplies are problematic and there is a very high maintenance requirement requiring site to have an intimate knowledge of this equipment. This

BACKGROUND

expertise does not currently exist at site so Engineering is relied on. Spare parts are currently not an issue but are no longer available from the original equipment manufacturer (OEM).

Governors: Power supplies are failing, servo motor pistons are bypassing oil, governor cards are failing and there is overheating in the cabinet. Spare parts are currently not an issue but are no longer being supplied by the original OEM. The governors require frequent maintenance.

Intake Gates: The base of the intake gates is losing material, making it difficult to achieve a sufficient seal and extending outages that require unit dewatering.

A capital investment was raised for scope development (C55 Investment code 11651) for the overhaul of multiple Long Spruce units. During the scope development phase, the project team reviewed the options for refurbishment of the units for safe and reliable operations. It was determined that Unit 9 would be overhauled in sequence as per the project plan, as the remaining units are still in need of minor or major overhauls and individual CIJs will be completed for each unit.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

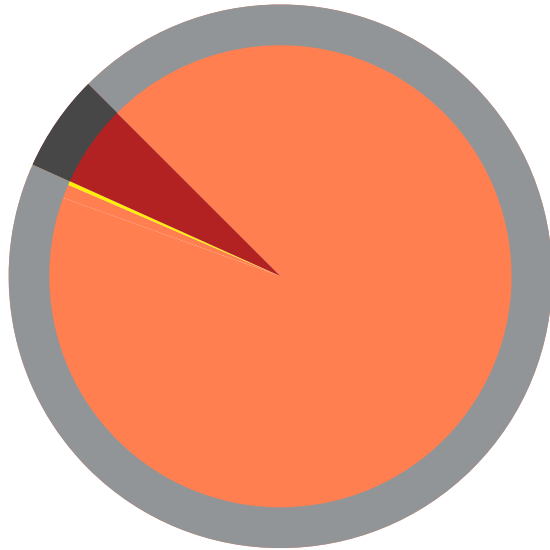
JUSTIFICATION

This investment will maximize the value of Long Spruce Unit 9 by returning assets to good or very good condition, improving unit availability and reliability.

The investment will mitigate the lost generation risk associated with failure of the identified systems at risk and the resulting consequential damage. Major failures often result in damage that cannot be quickly repaired resulting in forced outages ranging from months to years.

Portfolio optimization selected this alternative to be executed in order to balance the whole life cycle costing of the Long Spruce Generating Station Facility, reliability of the unit and economics of revenue benefits. This unit was selected to be executed based on the condition of its components and this alternative was selected based on station reliability benefit gains at this time.

CORPORATE VALUE FRAMEWORK



Value Measure	Value Points	% of Value
Lost Generation Risk	143,697	93.08%
O&M Financial Benefits	417	0.27%
Safety Risk	0	0%
Environmental Risk	0	0%
Total Cost	-10,258	6.65%
Total Value	133,856	
Value/\$K	13.05	

ANALYSIS OF ALTERNATIVES:

ECONOMIC ANALYSIS

Discount Rate	For current corporate rates see P911 6%
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Active Option	NPV Benefits/(Costs)	CVF Score	Value/\$K
Unit Overhaul, Base Scope		133,856	13.05

Other Alternatives	NPV Benefits/(Costs)	CVF Score	Value/\$K
See Other Alternatives Considered section			

INVESTMENT RISK ANALYSIS

Total contingency carried: \$1,450,000. The breakdown is provided below.

Scope:

- There is a risk that scope will change during the project due to new information being discovered during unit disassembly and inspection that was previously unavailable or due to unexpected changes in component condition. The scope change process will be used to manage and justify any additional new scope items raised. The probability of this risk is high and \$400,000 is carried.
- There is a risk that on the job training may be required. The probability of this risk is high and \$250,000 is carried.

Schedule:

- There is a risk that scheduled in-service dates slip or unit orders change based on outage opportunities, water conditions, changes in scope or other emergency repairs. This will be mitigated by detailing outage schedules and scheduling outages as far in advance as possible. The probability of this risk is low and \$100,000 is carried.
- There is a risk that room availability in the Gillam area becomes limited if other major projects in the Lower Nelson River area are executing at the same time. If contractors need to mobilize their own accommodations, there may be impacts to the schedule and budget. This will be mitigated by monitoring and coordinating with other projects, but overlap is possible. The probability of this risk is medium and \$100,000 is carried.
- There is a risk that a Direct Negotiate Contract will be required. The probability of this risk is high and \$200,000 is carried.

Budget:

- Major contracts have not been awarded. There is risk that the bids received do not align with the estimates generated. This has been mitigated by building estimates from recent work completed; however, market conditions may result in unexpected bid prices. The probability of this risk is medium and \$200,000 is carried.
- There is a risk that the internal labour required to complete this work does not align with estimates due to synergies with other projects or changes in staff. This will be monitored and updated as the work progresses to predict the overall expected cost. The probability of this risk is medium and \$200,000 is carried.

There is an additional risk that the selected project execution alternative may be required to change once execution commences. The change would be driven by previously unavailable performance and asset condition information.

INVESTMENT RISK ANALYSIS

No contingency is being carried specifically for this risk and if realized, an addendum would be necessary.

ESTIMATED COST FLOW

The annual projected cost flows are as follows (in thousands of dollars):

Fiscal Year	Budget	Contributions	Net Budget
Prev. Actuals	\$0	\$0	\$0
2023/2024	\$728	\$0	\$728
2024/2025	\$3,526	\$0	\$3,526
2025/2026	\$6,785	\$0	\$6,785
2026/2027	\$1,305	\$0	\$1,305
2027/2028	\$0	\$0	\$0
2028/2029+	\$0	\$0	\$0
Total	\$12,344	\$0	\$12,344

IMPACT ON O&A COSTS

No additional O&A costs have been identified as a result of this project.

PROPOSED SCHEDULE

FY 2024: Specification writing, design and procurement.
FY 2025: Procurement and external design.
FY 2026: Manufacturing and construction.
FY 2027: Construction and commissioning/closure.

RELATED INVESTMENTS

Long Spruce Overhauls - C55 ID 11651; LS Unit 10 – C55 ID 26410

OTHER ALTERNATIVES CONSIDERED

The following alternatives were considered during scope development:

- Alternative 2 is the base scope outlined in Alternative 1 (the selected alternative for this unit) plus a stator replacement.
- Alternative 3 includes base scope, stator replacement and unit re-running.

The Long Spruce overhaul investment had many permutations and combinations of scope items for consideration. Scope item inclusion decisions and scope item alternatives were evaluated and the combinations assessed. The overall risk performance and cost balancing was not optimal for Alternative 2 and 3 for this unit.

REFERENCE DOCUMENTS

CAPITAL INVESTMENT CONCEPT FOR

Long Spruce Units 6,7&9 Minor Overhauls

Investment Type (Project)

SCOPE DEVELOPMENT FUNDS:	\$250
CONCEPT ESTIMATE (incl. Scope Development):	\$24,778
CONTRIBUTIONS:	\$0
NET CONCEPT ESTIMATE (incl. Scope Development):	\$24,778
(values listed above are in thousands of dollars)	
CORPORATE VALUE	Value: 1,652,252
FRAMEWORK SCORE :	Value/\$K: 89.27

DATE PREPARED: 2018/01/22

EC/MHEB APPROVAL MINUTE & DATE:

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
TURNER, HAL	DIRECTOR GENERATION ASSET MANAGEMENT		Director - Generation Asset Management	2018/01/24
GAREAU, JULES	GENERATION MTCE & OPS SUPPORT DEPT MGR		Generation Maintenance and Oper Support	2018/01/24
SYLVESTRE, JORDAN	ELECTRICAL SECTION HEAD		Generation Maintenance and Oper Support	2018/01/24
BISHOP, GARY	GEN ASSET STRATEGY & PERF DEPT MANAGER		Generation Asset Strategy and Performanc	2018/01/23
ALLARD, KATHLEEN	ASSET INVESTMENT PLANNING SECTION HEAD		Generation Asset Strategy and Performanc	2018/01/23
BORTOLUZZI, LINDSEY	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2018/01/23
EDWARDS, ALAINA	PROJECT CONTROL & REPORTING OFFICER		Generation Project Management	2018/01/22
ALLARD, KATHLEEN	ASSET INVESTMENT PLANNING SECTION HEAD		Generation Asset Strategy and Performanc	2018/01/22

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Generation & Wholesale	REQUESTING OPERATING/CORPORATE GROUP:	Generation & Wholesale
RESPONSIBLE DIVISION:	Generation Asset Management	REQUESTING DIVISION:	Generation North
RESPONSIBLE DEPARTMENT:	Generation Asset Strategy and Performanc	ISD: (YYYY/MM/DD)	2023/06/30
I.M. NODE NUMBER:	2.1.20.15.02.74	W.B.S. NUMBERS:	P:28813
C55 INVESTMENT CODE:	11651		
SAP PROJECT TYPE:	24 - BOC-VP & Management	C55 INVESTMENT SUB-CATEGORY:	Single WBS
CORPORATE INVESTMENT CATEGORIES:	(Level 1) C3 / Sustainment (Level 2) CM / System Renewal		

CONTACTS			
PREPARED BY:	KJARTANSON, DERRICK STAFF OFFICER 51460	REQUESTOR:	SYLVESTRE, JORDAN (jsylvestre)
PROJECT MANAGER:	unassigned, unassigned		

MANITOBA HYDRO CAPITAL INVESTMENT CONCEPT LS Units 6,7&9 Minor Overhauls

RECOMMENDATION

Approve a budget for the scope development phase for minor overhauls of Units 6, 7 and 9 at Long Spruce Generating Station.

SCOPE

The deliverables of the scope development phase will include:

- Investigation and analysis of components requiring work that could be done during a specified unit outage;
- Preparation of Concept Design Report(s) for each unit and major items as required;
- Preparation of a Project Plan including detailed estimate of scope, budget and schedule for each alternative, project risk mitigation, hazardous materials management program / environmental screening report, and stakeholder engagement plan;
- Detailed investment evaluation within the Corporate Value Framework of all feasible alternative solutions; and
- Completion of the Capital Investment Justification (CIJ).

Major component items included in scope for review:

- Rotor;
- Stator;
- Generator Step Up (GSU) Transformers;
- Generator Breaker;
- Exciters;
- Governors;
- Surface Air Coolers;
- Unit Controls; and
- Intake Gates

Not In-Scope:

- Turbine/Runner Replacement

BACKGROUND

The scope development phase includes all components of the units potentially requiring work in the next 5-10 years planning construction work such that there are three units per project. The scope from the LS U1-10 Governor, Exciter & GSU Replacement Project has been included in this project.

Current condition assessment information and past job track requests were used to identify the components under consideration for scope.

The following components and their current known condition are as follows:

Rotor - needs assessment
Stator - needs assessment

BACKGROUND

Exciters - Condition Score: Fair, assessed at 4.7/10

Cooling modification performed on the rotor in the early 2000s, impacting the power factor of these units. Unfortunately, the impact to some auxiliary equipment was not taken into consideration and now the excitation transformers are now underrated. To mitigate this, temporary fans have been plugged into the wall on a permanent basis and run for a majority of the year. Without this, the transformers would trip on a high temperature alarm.

In addition, there currently are no spare field breakers for these exciters. The power supplies are problematic and there is a very high maintenance requirement on these exciters. The exciters require site to have an intimate knowledge of this equipment. Currently this does not exist at site and Engineering is heavily relied on. Spare parts are currently not an issue but are not being supplied by the original equipment manufacturer (OEM).

Governors - Condition Score: Fair, assessed at 6.9/10 in 2017

The power supplies are failing, servo motor pistons are bypassing oil, governor cards failing, overheating in the cabinet, small oscillation (problem unknown). Spare parts are currently not an issue but are not being supplied by the original OEM. The governors currently require a lot of maintenance.

Transformers - Condition Score: Fair, assessed at 5.83/10

For the most part these transformers are in good condition however it may be optimal to slightly advance the GSU replacement in order to optimize outage requirements. The bushings have failed in the past on multiple transformers. The bushings have been changed out on all the units at least twice and the transformers are approaching 40 years old. The station has two spares that can be utilized in the event of a failure, however if a transformer were to fail then a replacement program should be started immediately.

The Surface Air Coolers (SAC) are 38 years old and prone to leakage. Between 1994 and 2015, 125 leaks have been detected amongst the units or an average of approximately 6 leaks per year. Between 2010 and 2015, site staff spent 1793 hours of labor repairing 41 leaks. Between 2011 and 2016, SAC leaks resulted in 3 unit forced outages, one of which caused a fault and lead to a fire.

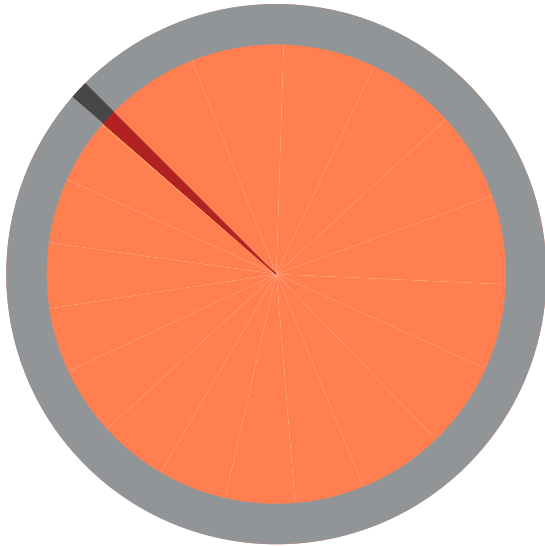
The bottom of the Intake Gates is losing material, making it difficult to get a good seal.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

JUSTIFICATION

The generating units at Long Spruce are drive train assets, which are critical in the production of power. The purpose of this CIC is to determine the optimal replacement / refurbishment to ensure reliable power generation while extracting the maximum operation value of the asset before replacement.

CORPORATE VALUE FRAMEWORK



Value Measure	Value Points	% of Value
Lost Generation Risk	1,670,084	98.86%
O&M Financial Benefits	641	0.04%
Financial Risk	36	0%
Environmental Risk	0	0%
Safety Risk	0	0%
Total Cost	-18,509	1.1%
Total Value	1,652,252	
Value/\$K	89.27	

OTHER ALTERNATIVES CONSIDERED

Alternatives will be developed and addressed within the concept development phase. Combinations or separations of scope items will be reviewed during the corporate value framework evaluation process.

INVESTMENT RISK ANALYSIS

There is a small risk that the value of all alternatives identified will diminish with further evaluation and as scope is developed such that it will no longer be recommended to proceed with this capital investment and all sunk cost will need to be expensed.

Opportunities to minimize outages and maximize resource efficiencies for this and parallel investments in the portfolio will be monitored and evaluated as a function of the portfolio selection process. Any such opportunities that have an impact on the scope or scheduling of this investment realized on their own merits may result in an addendum.

ESTIMATED COST FLOW

The annual projected cost flows are as follows (in thousands of dollars):

Fiscal Year	Scope Development Funds	Concept Estimate	Total Estimated Investment (Net of Contrib.)
Prev. Actuals	\$0	\$0	\$0
2017/2018	\$14	\$14	\$14
2018/2019	\$236	\$236	\$236
2019/2020	\$0	\$75	\$75
2020/2021	\$0	\$1,952	\$1,952
2021/2022	\$0	\$11,354	\$11,354
2022/2023+	0	\$11,146	\$11,146
Total	\$250	\$24,777	\$24,777

IMPACT ON O&A COSTS

Impact to O&A costs is unknown at this time and will be assessed throughout the scope development of the investment.

RELATED INVESTMENTS

Long Spruce Units 3,4&8 Minor Overhauls CL #4526

REFERENCE DOCUMENTS

[11651 CIC LS Units 6,7 9 Minor Overhauls.docx](#)

**CAPITAL INVESTMENT CONCEPT ADDENDUM
FOR**

**Long Spruce Units 6,7&9 Minor Overhauls
Investment Type (Project)
Addendum Number 1**

	<u>PREVIOUSLY APPROVED</u>	<u>REVISED</u>	<u>INCREASE / (DECREASE)</u>
SCOPE DEVELOPMENT:	\$326	\$583	\$257
CONCEPT ESTIMATE (incl. Scope Development):	\$24,778	\$38,793	\$14,015
CONTRIBUTIONS:	\$0	\$0	\$0
NET CONCEPT ESTIMATE (incl. Scope Development):	\$24,778	\$38,793	\$14,015
	(values listed above are in thousands of dollars)		
CORPORATE VALUE	Value: 111,066	Value: 147,817	
FRAMEWORK SCORE :	Value/\$K: 0.00	Value/\$K: 5.05	

DATE PREPARED: 2018/11/20

EC/MHEB APPROVAL MINUTE &
DATE:

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
MIDFORD, LORNE	VP GENERATION & WHOLESALE		Vice President – Generation & Wholesale	2019/01/21
TURNER, HAL	DIRECTOR GENERATION ASSET MANAGEMENT		Director - Generation Asset Management	2018/12/14
BISHOP, GARY	GEN ASSET STRATEGY & PERF DEPT MANAGER		Generation Asset Strategy and Performanc	2018/12/13
GAREAU, JULES	GENERATION MTCE & OPS SUPPORT DEPT		Generation Maintenance and Oper Support	2018/12/13
MILLER, SANDY	GENERATION PROJECT MANAGEMENT DEPT		Generation Project Management	2018/12/13
Johnson, Erin	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2018/12/12
EDWARDS, ALAINA	PROJECT CONTROL & REPORTING OFFICER		Generation Project Management	2018/11/22
JENSEN, ROB	ACTING AIP SECTION HEAD	On behalf Of ALLARD, KATHLEEN (kallard).	Generation Asset Strategy and Performanc	2018/11/20

ADDENDUM NUMBER	DATE	REVISION (Summary of change)

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Generation & Wholesale	REQUESTING OPERATING/CORPORATE GROUP:	Generation & Wholesale
RESPONSIBLE DIVISION:	Generation Asset Management	REQUESTING DIVISION:	Generation Operations and Maintenance
RESPONSIBLE DEPARTMENT:	Generation Project Management	ISD: (YYYY/MM/DD)	2019/11/30
I.M. NODE NUMBER:	2.1.20.15.02.74	W.B.S. NUMBERS:	P:28813, P:30707
C55 INVESTMENT CODE:	11651		
SAP PROJECT TYPE:	24 - BOC-VP & Management	C55 INVESTMENT SUB-CATEGORY:	Shell
CORPORATE INVESTMENT CATEGORIZATION:	(Level 1) C3 / Sustainment (Level 2) CM / System Renewal		

CONTACTS			
PREPARED BY:	KJARTANSON, DERRICK STAFF OFFICER 51460	REQUESTOR:	SYLVESTRE, JORDAN (jsylvestre)
PROJECT MANAGER:	QUAYLE, MICHAEL PROFESSIONAL ENGINEER 51460		

MANITOBA HYDRO

CAPITAL INVESTMENT CONCEPT ADDENDUM

Long Spruce Units 6,7&9 Minor Overhauls

RECOMMENDATION

Increase the budget for the scope development phase by \$257k to \$583k for minor overhauls of Units 6, 7 and 9 to include assessments by an external consultant and root cause analysis of high inter-neutral currents at Long Spruce Generating Station.

SCOPE

New Scope:

- Original Equipment Manufacture (OEM) involvement to investigate and perform root cause analysis of high inter-neutral currents occurring in the stator.

The deliverables of the scope development phase remain otherwise unchanged and will include:

- Investigation and analysis of components requiring work that could be done during a specified unit outage;
- Preparation of a scope development report(s) for each unit and major items as required;
- Preparation of a project plan including detailed estimate of scope, budget and schedule for each alternative, project risk mitigation, hazardous materials management program / environmental screening report, and stakeholder engagement plan;
- Detailed investment evaluation within the Corporate Value Framework of all feasible alternative solutions; and
- Completion of the Capital Investment Justification (CIJ).

Major component items included in scope for review:

- Rotor;
- Stator;
- Generator step up (GSU) transformers;
- Generator breaker;
- Exciters;
- Governors;
- Surface air coolers;
- Unit controls; and
- Intake gates

Not In-Scope:

- Turbine/runner replacement

BACKGROUND

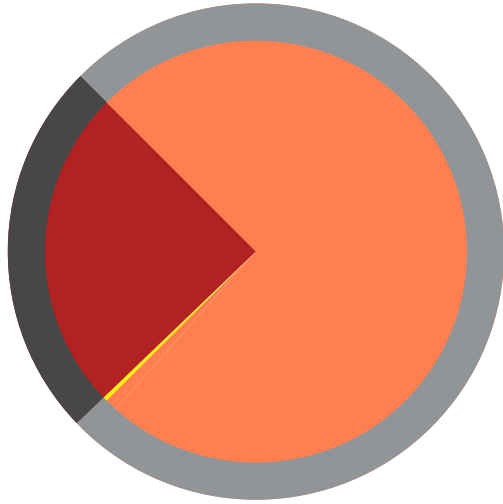
The project team is investigating high inter-neutral currents that are occurring in all generators leading to forced outages, particularly in the summer months when ambient temperature is the highest. Various assessments have been done internally but OEM input is required to determine the root cause of the issue.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

JUSTIFICATION

The generating units at Long Spruce are drive train assets, which are critical in the production of power. The increase in scope development is required to determine the optimal replacement / refurbishment plan to ensure reliable power generation while extracting the maximum operation value of the asset before replacement.

CORPORATE VALUE FRAMEWORK (REVISED)



Value Measure	Value Points	% of Value
Lost Generation Risk	176,325	85.46%
O&M Financial Benefits	700	0.34%
Financial Risk	40	0.02%
Environmental Risk	0	0%
Safety Risk	0	0%
Total Cost	-29,248	14.18%
Total Value	147,817	
Value/\$K	5.05	

OTHER ALTERNATIVES CONSIDERED

Alternatives will be developed and addressed within the concept development phase. Combinations or separations of scope items will be reviewed during the corporate value framework evaluation process.

INVESTMENT RISK ANALYSIS

There is a small risk that the value of all alternatives identified will diminish with further evaluation and it will no longer be recommended to proceed with this capital investment. If this occurs, project costs incurred will need to be expensed.

Opportunities to minimize outages and maximize resource efficiencies for this and parallel investments in the portfolio will be monitored and evaluated as a function of the portfolio selection process. Any such opportunities that have an impact on the scope or scheduling of this investment realized on their own merits may result in an addendum.

MANITOBA HYDRO
CAPITAL INVESTMENT CONCEPT ADDENDUM
Long Spruce Units 6,7&9 Minor Overhauls

ESTIMATED COST FLOW

The annual projected cost flows are as follows (in thousands of dollars):

	PREVIOUSLY APPROVED			PROPOSED			INCREASE/ (DECREASE)		
Fiscal Year	Scope Development Funds	Concept Estimate	Total Estimated Investment (Net of Contrib.)	Scope Development Funds	Concept Estimate	Total Estimated Investment (Net of Contrib.)	Scope Development Funds	Concept Estimate	Total Estimated Investment (Net of Contrib.)
Prev. Actuals/ Approved	\$14	\$14	\$14	\$1	\$1	\$1	\$ (13)	\$ (13)	\$ (13)
2018/2019	\$236	\$236	\$236	\$375	\$375	\$375	\$ 139	\$ 139	\$ 139
2019/2020	\$75	\$75	\$75	\$207	\$417	\$417	\$ 132	\$ 342	\$ 342
2020/2021	\$1	\$1,952	\$1,952	\$0	\$2,600	\$2,600	\$ (1)	\$ 648	\$ 648
2021/2022	\$0	\$11,354	\$11,354	\$0	\$3,900	\$3,900	\$ -	\$ (7,454)	\$ (7,454)
2022/2023+	\$0	\$11,146	\$11,146	\$0	\$31,500	\$31,500	\$ -	\$ 20,354	\$ 20,354
Total	\$326	\$24,777	\$24,777	\$583	\$38,793	\$38,793	\$ 257	\$ 14,016	\$ 14,016

IMPACT ON O&A COSTS

Impact to O&A costs is unknown at this time and will be assessed throughout the scope development of the investment.

MANITOBA HYDRO
CAPITAL INVESTMENT CONCEPT ADDENDUM
Long Spruce Units 6,7&9 Minor Overhauls

RELATED INVESTMENTS

Long Spruce Units 3,4&8 Minor Overhauls CL #4526

REFERENCE DOCUMENTS

[11651_CIC_LS Units 6,7_9 Minor Overhauls.docx](#)

CAPITAL INVESTMENT JUSTIFICATION FOR

Long Spruce Unit 2 Overhaul

Investment Type (Project)

BUDGET:	\$12,481
CONTRIBUTIONS:	\$0
NET BUDGET:	\$12,481
(values listed above are in thousands of dollars)	
CORPORATE VALUE	Value: 73,245
FRAMEWORK SCORE:	Value/\$K: 6.75

DATE PREPARED: 2022-02-10

EC/MHEB APPROVAL MINUTE &
DATE:

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
Turner, Hal	VP ASSET PLANNING & DELIVERY		VP Asset Planning & Delivery	2022-03-19
Pawluk, James	DIRECTOR ASSET MANAGEMENT		Director - Asset Management	2022-03-18
Bowen, Dave	DIRECTOR PROJECT MANAGEMENT		Director Project Management	2022-03-18
Halayko, Krista	ASSET MGMT STRATEGY & PLANNING DEPT MGR		Asset Management Strategy & Planning	2022-03-08
Orellana, Cristian	GENERATION PROJECTS DEPARTMENT MANAGER		Generation Projects	2022-03-03
Johnson, Erin	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2022-03-03
Swait, Caitlin	FINANCIAL SERVICES LEAD - GEN PROJECTS		Project Services	2022-02-10
Dlot, Aaron	ASSET INVESTMENT PLANNING SECTION HEAD		Asset Management Strategy & Planning	2022-02-10

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Asset Planning & Delivery	REQUESTING OPERATING/CORPORATE GROUP:	Asset Planning & Delivery
RESPONSIBLE DIVISION:	Asset Management	REQUESTING DIVISION:	Asset Management
RESPONSIBLE DEPARTMENT:	Asset Management Strategy & Planning	ISD: (YYYY/MM/DD)	2025/03/31
I.M. NODE NUMBER:	2.1.20.15.02.120	W.B.S. NUMBERS:	P:36119
C55 INVESTMENT CODE:	26404		
SAP PROJECT TYPE:	24 - BOC-VP & Management	C55 INVESTMENT SUB-CATEGORY:	Single WBS
CORPORATE INVESTMENT CATEGORIES:	(Level 1) C3 / Sustainment (Level 2) CM / System Renewal		

CONTACTS			
PREPARED BY:	Hildebrand, David ASSET ADVISOR - ELECTRICAL APPARATUS 51220	REQUESTOR:	SYLVESTRE, JORDAN (jsylvestre)
PROJECT MANAGER:	Wallace, Heather PROJECTS ENGINEER 51460		

MANITOBA HYDRO CAPITAL INVESTMENT JUSTIFICATION Long Spruce Unit 2 Overhaul

RECOMMENDATION

Approve a budget of \$12.5M for the execution of an overhaul of Unit 2 at Long Spruce Generating Station to extend its useful life.

SCOPE

The scope of work includes:

- Mechanical Upgrades: Bearing refurbishment, surface air cooler replacement, crane upgrade, hazardous material abatement, rotor re-shrink and restoration of stator circularity.
- Electrical Upgrades: Governor upgrade, rotor pole re-insulation, exciter replacement, generator circuit breaker replacement, and Unit Control Monitoring System (UCMS) upgrades.

The scope of work excludes GSU transformers, stator replacement, generator protection, turbine regulating mechanism overhaul and re-running.

BACKGROUND

Long Spruce Unit 2 has been in-service for approximately 42 years, with a generating capacity of 98 MW. Due to some known deficiencies, outlined in further detail below, scope development was approved. The scope development phase assessed these issues and investment alternatives were crafted for evaluation in the Generation Portfolio.

Current condition assessment information and historical JobTrac requests were used to identify the components under consideration for scope.

The following components and their current known conditions are as follows:

Rotor: Fretting corrosion has been identified at the rotor spider to rim ledge as well as several cracks at the torque blocks. The rotor rim floats due to loss of shrink; an interference fit between the rim and rotor spider. A floating rim can cause fretting fatigue damage of the rotor rim shelf and may ultimately lead to the need for costly rotor disassembly and repairs or in the worst case, catastrophic failure of the rotor.

Stator: Replacement was reviewed using a whole-life cost model analysis and portfolio optimization. Replacement is not recommended at this time. Stator circularity will be reviewed and addressed based on condition during the overhaul.

Exciters: A cooling modification was performed on the rotor in the early 2000s, impacting the power factor of these units. Unfortunately, the impact to some auxiliary equipment was not taken into consideration and the excitation transformers are now underrated. To mitigate overheating issues, temporary fans have been plugged into the wall on a permanent basis and are run for a majority of the year. Without this, the transformers would trip on a high temperature alarm.

In addition, there currently are no spare field breakers for these exciters, the power supplies are problematic and there is a very high maintenance requirement requiring site to have an intimate knowledge of this equipment. This

BACKGROUND

expertise does not currently exist at site so Engineering is relied on. Spare parts are currently not an issue but are no longer available from the original equipment manufacturer (OEM).

Governors: Power supplies are failing, servo motor pistons are bypassing oil, governor cards are failing and there is overheating in the cabinet. Spare parts are currently not an issue but are no longer being supplied by the original OEM. The governors require frequent maintenance.

Surface Air Coolers (SAC): The SACs are 38 years old and prone to leakage. Between 1994 and 2015, 125 leaks have been detected amongst the units or an average of approximately 6 leaks per year. Between 2010 and 2015, site staff spent 1,793 hours of labor repairing 41 leaks. Between 2011 and 2016, SAC leaks resulted in 3 unit forced outages, one of which caused a fault and resulted in a fire.

Intake Gates: The base of the intake gates is losing material, making it difficult to achieve a sufficient seal and extending outages that require unit dewatering.

A capital investment was raised for scope development (C55 Investment code 11651) for the overhaul of multiple Long Spruce units. During the scope development phase, the project team reviewed the options for refurbishment of the units for safe and reliable operations. It was determined that Unit 2 would be the first unit overhauled. The remaining units are still in need of minor or major overhauls and individual CIJs will be completed for each unit.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

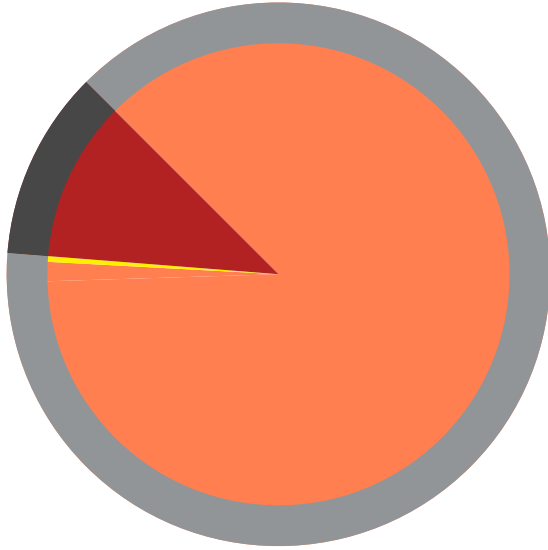
JUSTIFICATION

This investment will maximize the value of Long Spruce Unit 2 by returning assets to good or very good condition, improving unit availability and reliability.

The investment will mitigate the lost generation risk associated with failure of the identified systems at risk and the resulting consequential damage. Major failures often result in damage that cannot be quickly repaired resulting in forced outages ranging from months to years.

Portfolio optimization selected this alternative to be executed in order to balance the whole life cycle costing of the Long Spruce Generating Station Facility, reliability of the unit and economics of revenue benefits. This unit was selected to be executed to first based on the condition of its components and alternative was selected based on station reliability benefit gains at this time.

CORPORATE VALUE FRAMEWORK



Value Measure	Value Points	% of Value
Lost Generation Risk	83,716	88.35%
O&M Financial Benefits	380	0.4%
Environmental Risk	0	0%
Safety Risk	0	0%
Total Cost	-10,851	11.25%
Total Value	73,245	
Value/\$K	6.75	

ANALYSIS OF ALTERNATIVES:

ECONOMIC ANALYSIS		
Discount Rate	For current corporate rates see P911	
	6%	

Active Option	NPV Benefits/(Costs)	CVF Score	Value/\$K
Unit Overhaul, Base Scope		73,245	6.75

Other Alternatives	NPV Benefits/(Costs)	CVF Score	Value/\$K
See Other Alternatives Considered section			

INVESTMENT RISK ANALYSIS
<p>Total contingency carried: \$1,850,000. The breakdown is provided below.</p> <p>Scope:</p> <ul style="list-style-type: none"> • There is a risk that scope will change during the project due to new information being discovered during unit disassembly and inspection that was previously unavailable or due to unexpected changes in component condition. The scope change process will be used to manage and justify any additional new scope items raised. The probability of this risk is high and \$400,000 is carried. • There is a risk that on the job training may be required. The probability of this risk is high and \$250,000 is carried. <p>Schedule:</p> <ul style="list-style-type: none"> • There is a risk that scheduled in-service dates slip or unit orders change based on outage opportunities, water conditions, changes in scope or other emergency repairs. This will be mitigated by detailing outage schedules and scheduling outages as far in advance as possible. The probability of this risk is low and \$100,000 is carried. • There is a risk due to the limited space within the existing layout impacting movement, storage and execution. This will be mitigated by including information on the configuration in the design and contracts. An exterior structure may be required, in addition to relocation of the Emergency Response Room. The probability of this risk is high and \$400,000 is carried. • There is a risk that room availability in the Gillam area becomes limited if other major projects in the Lower Nelson River area are executing at the same time. If contractors need to mobilize their own accommodations, there may be impacts to the schedule and budget. This will be mitigated by monitoring and coordinating with other projects, but overlap is possible. The probability of this risk is medium and \$100,000 is carried. • There is a risk that a Direct Negotiate Contract will be required. The probability of this risk is high and \$200,000 is carried. <p>Budget:</p> <ul style="list-style-type: none"> • Major contracts have not been awarded. There is risk that the bids received do not align with the estimates generated. This has been mitigated by building estimates from recent work completed; however, market conditions may result in unexpected bid prices. The probability of this risk is medium and \$200,000 is carried. • There is a risk that the internal labour required to complete this work does not align with estimates due to synergies with other projects or changes in staff. This will be monitored and updated as the work progresses to

INVESTMENT RISK ANALYSIS

predict the overall expected cost. The probability of this risk is medium and \$200,000 is carried.

There is an additional risk that the selected project execution alternative may be required to change once execution commences. The change would be driven by previously unavailable performance and asset condition information. No contingency is being carried specifically for this risk and if realized, an addendum and CFO authorization would be necessary.

ESTIMATED COST FLOW

The annual projected cost flows are as follows (in thousands of dollars):

Fiscal Year	Budget	Contributions	Net Budget
Prev. Actuals	\$0	\$0	\$0
2022/2023	\$771	\$0	\$771
2023/2024	\$3,275	\$0	\$3,275
2024/2025	\$7,427	\$0	\$7,427
2025/2026	\$1,009	\$0	\$1,009
2026/2027	\$0	\$0	\$0
2027/2028+	\$0	\$0	\$0
Total	\$12,481	\$0	\$12,481

IMPACT ON O&A COSTS

No additional O&A costs have been identified as a result of this project.

PROPOSED SCHEDULE

FY 2023: Specification writing, design and procurement.
FY 2024: Procurement and external design.
FY 2025: Manufacturing and construction.
FY 2026: Construction and commissioning/closure.

RELATED INVESTMENTS

Long Spruce Minor Overhauls - C55 ID 11651

OTHER ALTERNATIVES CONSIDERED

The following alternatives were considered during scope development:

- Alternative 2 is the base scope outlined in Alternative 1 (the selected alternative for this unit) plus a stator replacement.

OTHER ALTERNATIVES CONSIDERED

- Alternative 3 includes base scope, stator replacement and unit re-running.

The Long Spruce overhaul investment had many permutations and combinations of scope items for consideration. Scope item inclusion decisions and scope item alternatives were evaluated and the combinations assessed. The overall risk performance and cost balancing was not optimal for Alternative 2 and 3 for this unit.

REFERENCE DOCUMENTS

[Financial chart Long Spruce Unit 2 Minor Overhaul.xlsx](#)

CAPITAL INVESTMENT JUSTIFICATION FOR

Long Spruce Unit 10 Overhaul

Investment Type (Project)

BUDGET:	\$12,666
CONTRIBUTIONS:	\$0
NET BUDGET:	\$12,666
(values listed above are in thousands of dollars)	
CORPORATE VALUE	Value: 74,383
FRAMEWORK SCORE:	Value/\$K: 7.55

DATE PREPARED: 2022-08-27

EC/MHEB APPROVAL MINUTE &
DATE:

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
Turner, Hal	VP ASSET PLANNING & DELIVERY		VP Asset Planning & Delivery	2022-09-22
Pawluk, James	DIRECTOR ASSET MANAGEMENT		Director - Asset Management	2022-09-21
Ward, Ryan	DIRECTOR PROJECT MANAGEMENT		Director Project Management	2022-09-09
Halayko, Krista	ASSET MGMT STRATEGY & PLANNING DEPT MGR		Asset Management Strategy & Planning	2022-09-09
Orellana, Cristian	GENERATION PROJECTS DEPARTMENT MANAGER		Generation Projects	2022-09-08
Johnson, Erin	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2022-08-31
Sage, Scott	PROJECT FINANCIAL ANALYST		Project Services	2022-08-29
Dlot, Aaron	ASSET INVESTMENT PLANNING SECTION HEAD		Asset Management Strategy & Planning	2022-08-27

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Asset Planning & Delivery	REQUESTING OPERATING/CORPORATE GROUP:	Asset Planning & Delivery
RESPONSIBLE DIVISION:	Project Management	REQUESTING DIVISION:	Asset Management
RESPONSIBLE DEPARTMENT:	Generation Projects	ISD: (YYYY/MM/DD)	2027/06/30
I.M. NODE NUMBER:	2.1.20.15.02.121	W.B.S. NUMBERS:	P:37024
C55 INVESTMENT CODE:	26410		
SAP PROJECT TYPE:	24 - BOC-VP & Management	C55 INVESTMENT SUB-CATEGORY:	Single WBS
CORPORATE INVESTMENT CATEGORIES:	(Level 1) C3 / Sustainment (Level 2) CN / System Efficiency		

CONTACTS			
PREPARED BY:	Swait, Caitlin FINANCIAL SERVICES LEAD - GEN PROJECTS 51185	REQUESTOR:	Dave Hildebrand, Asset Lifecycle Mgmt
PROJECT MANAGER:	Wallace, Heather PROJECTS ENGINEER 51460		

MANITOBA HYDRO

CAPITAL INVESTMENT JUSTIFICATION

Long Spruce Unit 10 Overhaul

RECOMMENDATION

Approve a budget of \$12.7 M for the execution of an overhaul of Unit 10 at Long Spruce Generating Station to extend its useful life.

SCOPE

The scope of work includes:

- Mechanical Upgrades: Bearing refurbishment, hazardous material abatement, rotor re-shrink and restoration of stator circularity.
- Electrical Upgrades: Governor upgrade, rotor pole re-insulation, exciter replacement, generator circuit breaker replacement, and Unit Control Monitoring System (UCMS) upgrades.

The scope of work excludes generator step-up (GSU) transformers, stator replacement, generator protection, turbine regulating mechanism overhaul and re-running.

BACKGROUND

Long Spruce Unit 10 has been in-service for approximately 42 years, with a generating capacity of 98 MW. Due to some known deficiencies, outlined in further detail below, scope development was approved. The scope development phase assessed these issues and investment alternatives were crafted for evaluation in the Portfolio.

Current condition assessment information and historical JobTrac requests were used to identify the components under consideration for scope.

The following components and their current known conditions are as follows:

Rotor: Fretting corrosion has been identified at the rotor spider to rim ledge as well as several cracks at the torque blocks. The rotor rim floats due to loss of shrink; an interference fit between the rim and rotor spider. A floating rim can cause fretting fatigue damage of the rotor rim shelf and may ultimately lead to the need for costly rotor disassembly and repairs or in the worst case, catastrophic failure of the rotor.

Stator: Replacement was reviewed using a whole-life cost model analysis and portfolio optimization. Replacement is not recommended at this time. Stator circularity will be reviewed and addressed based on condition during the overhaul.

Exciters: A cooling modification was performed on the rotor in the early 2000s, impacting the power factor of these units. Unfortunately, the impact to some auxiliary equipment was not taken into consideration and the excitation transformers are now underrated. To mitigate overheating issues, temporary fans have been plugged into the wall on a permanent basis and are run for a majority of the year. Without this, the transformers would trip on a high temperature alarm.

In addition, there currently are no spare field breakers for these exciters, the power supplies are problematic and there is a very high maintenance requirement requiring site to have an intimate knowledge of this equipment. This

BACKGROUND

expertise does not currently exist at site so Engineering is relied on. Spare parts are currently not an issue but are no longer available from the original equipment manufacturer (OEM).

Governors: Power supplies are failing, servo motor pistons are bypassing oil, governor cards are failing and there is overheating in the cabinet. Spare parts are currently not an issue but are no longer being supplied by the original OEM. The governors require frequent maintenance.

Intake Gates: The base of the intake gates is losing material, making it difficult to achieve a sufficient seal and extending outages that require unit dewatering.

A capital investment was raised for scope development (C55 Investment code 11651) for the overhaul of multiple Long Spruce units. During the scope development phase, the project team reviewed the options for refurbishment of the units for safe and reliable operations. It was determined that Unit 10 would be overhauled in sequence as per the project plan, as the remaining units are still in need overhauls and individual CIJs will be completed for each unit.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

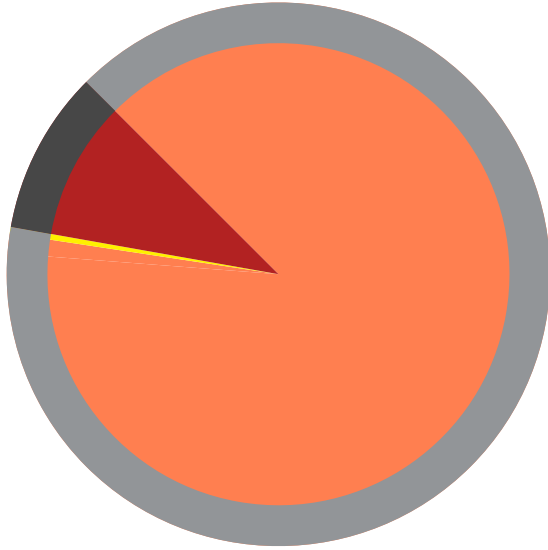
JUSTIFICATION

This investment will maximize the value of Long Spruce Unit 10 by returning assets to good or very good condition, improving unit availability and reliability.

The investment will mitigate the lost generation risk associated with failure of the identified systems at risk and the resulting consequential damage. Major failures often result in damage that cannot be quickly repaired resulting in forced outages ranging from months to years.

Portfolio optimization selected this alternative to be executed in order to balance the whole life cycle costing of the Long Spruce Generating Station Facility, reliability of the unit and economics of revenue benefits. This unit was selected to be executed based on the condition of its components and this alternative was selected based on station reliability benefit gains at this time.

CORPORATE VALUE FRAMEWORK



Value Measure	Value Points	% of Value
Lost Generation Risk	83,860	89.13%
O&M Financial Benefits	373	0.4%
Environmental Risk	0	0%
Safety Risk	0	0%
Total Cost	-9,849	10.47%
Total Value	74,383	
Value/\$K	7.55	

ANALYSIS OF ALTERNATIVES:

ECONOMIC ANALYSIS

Discount Rate	For current corporate rates see P911 6%
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Active Option	NPV Benefits/(Costs)	CVF Score	Value/\$K
Unit Overhaul, Base Scope		74,383	7.55

Other Alternatives	NPV Benefits/(Costs)	CVF Score	Value/\$K
See Other Alternatives Considered section			

INVESTMENT RISK ANALYSIS

Total contingency carried: \$1,450,000. The breakdown is provided below.

Scope:

- There is a risk that scope will change during the project due to new information being discovered during unit disassembly and inspection that was previously unavailable or due to unexpected changes in component condition. The scope change process will be used to manage and justify any additional new scope items raised. The probability of this risk is high and \$400,000 is carried.
- There is a risk that on the job training may be required. The probability of this risk is high and \$250,000 is carried.

Schedule:

- There is a risk that scheduled in-service dates slip or unit orders change based on outage opportunities, water conditions, changes in scope or other emergency repairs. This will be mitigated by detailing outage schedules and scheduling outages as far in advance as possible. The probability of this risk is low and \$100,000 is carried.
- There is a risk that room availability in the Gillam area becomes limited if other major projects in the Lower Nelson River area are executing at the same time. If contractors need to mobilize their own accommodations, there may be impacts to the schedule and budget. This will be mitigated by monitoring and coordinating with other projects, but overlap is possible. The probability of this risk is medium and \$100,000 is carried.
- There is a risk that a Direct Negotiated Contract will be required. The probability of this risk is high and \$200,000 is carried.

Budget:

- Major contracts have not been awarded. There is risk that the bids received do not align with the estimates generated. This has been mitigated by building estimates from recent work completed; however, market conditions may result in unexpected bid prices. The probability of this risk is medium and \$200,000 is carried.
- There is a risk that the internal labour required to complete this work does not align with estimates due to synergies with other projects or changes in staff. This will be monitored and updated as the work progresses to predict the overall expected cost. The probability of this risk is medium and \$200,000 is carried.

There is an additional risk that the selected project execution alternative may be required to change once execution commences. The change would be driven by previously unavailable performance and asset condition information.

INVESTMENT RISK ANALYSIS

No contingency is being carried specifically for this risk and if realized, an addendum would be necessary.

ESTIMATED COST FLOW

The annual projected cost flows are as follows (in thousands of dollars):

Fiscal Year	Budget	Contributions	Net Budget
Prev. Actuals	\$0	\$0	\$0
2024/2025	\$826	\$0	\$826
2025/2026	\$3,466	\$0	\$3,466
2026/2027	\$6,550	\$0	\$6,550
2027/2028	\$1,824	\$0	\$1,824
2028/2029	\$0	\$0	\$0
2029/2030+	\$0	\$0	\$0
Total	\$12,666	\$0	\$12,666

IMPACT ON O&A COSTS

No additional O&A costs have been identified as a result of this project.

PROPOSED SCHEDULE

FY 2025: Specification writing, design and procurement.
FY 2026: Procurement and external design.
FY 2027: Manufacturing and construction.
FY 2028: Construction and commissioning/closure.

RELATED INVESTMENTS

Long Spruce Overhauls - C55 ID 11651; LS Unit 9 – C55 ID 26409

OTHER ALTERNATIVES CONSIDERED

The following alternatives were considered during scope development:

- Alternative 2 is the base scope outlined in Alternative 1 (the selected alternative for this unit) plus a stator replacement.
- Alternative 3 includes base scope, stator replacement and unit re-running.

The Long Spruce overhaul investment had many permutations and combinations of scope items for consideration. Scope item inclusion decisions and scope item alternatives were evaluated and the combinations assessed. The overall risk performance and cost balancing was not optimal for Alternative 2 and 3 for this unit.

REFERENCE DOCUMENTS

C55-CIJ-PROJ

**CAPITAL INVESTMENT JUSTIFICATION
FOR**

[Aquatic Data Collection](#)

Investment Type (Project)

BUDGET:	\$25,951
CONTRIBUTIONS:	\$0
NET BUDGET:	\$25,951
(values listed above are in thousands of dollars)	
CORPORATE VALUE	Value: 244,057
FRAMEWORK SCORE:	Value/\$K: 11.75

DATE PREPARED: 2019/11/12

**EC/MHEB APPROVAL MINUTE &
DATE:** Approved by Jay Grewal
December 18, 2019

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
Midford, Lorne	VP GENERATION & WHOLESALE		VP Generation & Wholesale	2019/11/22
Turner, Hal	DIRECTOR GENERATION ASSET MANAGEMENT		Director - Generation Asset Management	2019/11/13
Cormie, David	DIRECTOR WHOLESALE POWER & OPERATIONS		Director - Wholesale Power & Ops	2019/11/13
Bishop, Gary	GEN ASSET STRATEGY & PERF DEPT MANAGER		Generation Asset Strategy and Performanc	2019/11/13
Penner, Wesley	HYDRAULIC OPERATIONS DEPARTMENT MANAGER		Hydraulic Engineering & Operations	2019/11/13
Derksen, Rich	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2019/11/12
Allard, Kathleen	PORTFOLIO PLANNER		Generation Asset Strategy and Performanc	2019/11/12
Allard, Kathleen	PORTFOLIO PLANNER		Generation Asset Strategy and Performanc	2019/11/12

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Generation & Wholesale	REQUESTING OPERATING/CORPORATE GROUP:	Generation & Wholesale
RESPONSIBLE DIVISION:	Wholesale Power & Operations	REQUESTING DIVISION:	Wholesale Power & Operations
RESPONSIBLE DEPARTMENT:	Director - Wholesale Power & Ops	ISD: (YYYY/MM/DD)	2025/03/31
I.M. NODE NUMBER:	2.1.20.15.04.10	W.B.S. NUMBERS:	P:32916
C55 INVESTMENT CODE:	23646		
SAP PROJECT TYPE:	22 - BOC-Executive Committee	C55 INVESTMENT SUB-CATEGORY:	Single WBS
CORPORATE INVESTMENT CATEGORIES:	(Level 1) C3 / Sustainment (Level 2) CO / Mandated Compliance		

CONTACTS			
PREPARED BY:	Allard, Kathleen PORTFOLIO PLANNER 51455	REQUESTOR:	Kristin Morand, Hydraulic Licensing Engineer
PROJECT MANAGER:	Penner, Wesley HYDRAULIC OPERATIONS DEPARTMENT MANAGER 51100		

MANITOBA HYDRO
CAPITAL INVESTMENT JUSTIFICATION
Aquatic Data Collection

RECOMMENDATION

Approve a budget of \$26.0 M to provide funding for the following investments:

- Coordinated Aquatic Monitoring Program (CAMP);
- Southern Indian Lake Environmental Monitoring Program; and
- Reservoir Greenhouse Gas Monitoring (RGHGM) program

The work in these investments provides required information for licencing requirements.

SCOPE

The scope of work related to the Coordinated Aquatic Monitoring Program (CAMP), Southern Indian Lake Environmental Monitoring program and the Reservoir Greenhouse Gas Monitoring program includes:

- Design, procurement and maintenance of monitoring tools and equipment
- Environmental monitoring & data gathering; and
- Public communications and engagement

BACKGROUND

Coordinated Aquatic Monitoring Program (CAMP)

CAMP was established in 2008, it is a long-term aquatic monitoring program to study and monitor the health of water bodies (rivers and lakes) affected by Manitoba Hydro's generating system. A Memorandum of Understanding (MOU) between the Province of Manitoba and Manitoba Hydro, signed in 2006, summarizes and defines the need for coordinating aquatic monitoring to address the growing expectations from environmental regulators, local communities, and the general public; and monitoring and assessment of Manitoba Hydro's hydroelectric generation system.

Southern Indian Lake Environmental Monitoring Program

Southern Indian Lake is one of the most impacted water bodies in Manitoba Hydro's system, yet little environmental monitoring was conducted after the 1980s. Although Southern Indian Lake has been impounded for over 30 years, erosion and sedimentation continues to be severe in some areas and over the past decade fish stocks that have supported the commercial and subsistence fisheries have declined to a state of collapse. The South Indian Lake Steering Committee, comprised of local stakeholders as well as Manitoba Hydro and Manitoba Sustainable Development, is developing a basic understanding of the aquatic environment to address concerns of the community, O Picon Na Piwin Cree Nation and the South Indian Lake Commercial Fishermen's Association.

Reservoir Greenhouse Gas Monitoring (RGHGM) Program

Manitoba Hydro's Reservoir Greenhouse Gas Monitoring has been an ongoing program designed to monitor GHG emissions at the Corporation's existing reservoirs; and to measure pre and post flooding GHG emissions at Manitoba Hydro's current and planned developments. The information collected by this program ensures an understanding of reservoir GHG emissions for current and planned operations, relative to other forms of electric power generation.

BACKGROUND

Monitoring has contributed the necessary data and analysis to support the understanding that any remaining reservoir GHG effect is negligible on both existing Winnipeg River reservoirs and mature northern flooded areas. The current focus of the program is to conduct comprehensive monitoring of pre and post flood GHG emissions at the Keeyask Project to demonstrate that Manitoba Hydro's newly developed hydropower is a low carbon source of power.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

JUSTIFICATION

The work in these programs is required by the Province in the Water Power Act licencing process to grant licences for the operation of Manitoba Hydro generation facilities. Without these operating licences, the generation facilities are unable to operate, potentially contributing to lost generation risk.

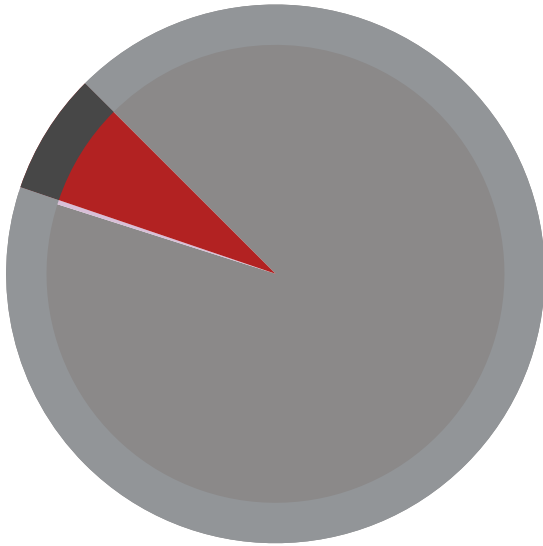
The Coordinated Aquatic Monitoring Program (CAMP), Southern Indian Lake (SIL) Environmental Monitoring Program, and Reservoir Greenhouse Gas Monitoring (RGHGM) program are in-effect in response to increased expectations from regulators, the CAMP Working Group, and the public for increased communications, engagement, results, and environmental monitoring data access. Additionally, changes in Aquatic Invasive Species Regulations have also contributed to a need for additional tools, equipment and labor to comply with decontamination and transport requirements.

This investment mitigates both compliance and stakeholder perception risks enabling the continued monitoring of the environment under agreements with provincial regulators, federal regulators and communities directly impacted by operations.

The initiatives develop a fuller appreciation of the environmental condition including key components such as fish populations, water and air conditions, and local concerns assisting Manitoba Hydro's planning and licensing activities.

Finally, the investment provides information that can aid in decision making toward proactive environmental mitigation planning, investment and preventative actions.

CORPORATE VALUE FRAMEWORK



Value Measure	Value Points	% of Value
Compliance Risk	263,956	92.42%
Stakeholder Perception Risk	880	0.31%
Total Cost	-20,779	7.28%
Total Value	244,057	
Value/\$K	11.75	

ANALYSIS OF ALTERNATIVES:

ECONOMIC ANALYSIS		
Discount Rate	For current corporate rates see P911 6%	

Active Option	NPV Benefits/(Costs)	CVF Score	Value/\$K
Aquatic and Greenhouse Gas Data		244,057	11.75

Other Alternatives	NPV Benefits/(Costs)	CVF Score	Value/\$K

INVESTMENT RISK ANALYSIS

The CAMP, RGHGM, and SIL programs all require consultants to gather data and interpret results. Much of the work involved is performed outdoors. Therefore there are risks that weather conditions or external resource constraints can contribute to project delays, increased costs, and data integrity.

ESTIMATED COST FLOW

The annual projected cost flows are as follows (in thousands of dollars):

Fiscal Year	Budget	Contributions	Net Budget
Prev. Actuals	\$0	\$0	\$0
2020/2021	\$4,410	\$0	\$4,410
2021/2022	\$5,416	\$0	\$5,416
2022/2023	\$4,763	\$0	\$4,763
2023/2024	\$4,872	\$0	\$4,872
2024/2025	\$6,490	\$0	\$6,490
2025/2026+	\$0	\$0	\$0
Total	\$25,951	\$0	\$25,951

IMPACT ON O&A COSTS

No significant, additional operational or maintenance costs have been identified as a result of this project.

PROPOSED SCHEDULE

In service date 2025/03/31

RELATED INVESTMENTS

WPA Water Licences
Lake Sturgeon Stewardship Regulations
Arctic BaySys and RCEA

OTHER ALTERNATIVES CONSIDERED

There are no other viable alternatives to be considered data collection is required to accommodate agreements with external stakeholders and regulators.

REFERENCE DOCUMENTS

C55-CIC

**CAPITAL INVESTMENT CONCEPT
FOR**

Portage Area Capacity Enhancement

Investment Type (Project)

SCOPE DEVELOPMENT FUNDS:	\$1,386
<hr/>	
CONCEPT ESTIMATE (incl. Scope Development):	\$137,319
CONTRIBUTIONS:	\$0
NET CONCEPT ESTIMATE (incl. Scope Development):	\$137,319
(values listed above are in thousands of dollars)	
CORPORATE VALUE	Value: 17,897
FRAMEWORK SCORE :	Value/\$K: 0.19

DATE PREPARED:

2019/08/08

**EC/MHEB APPROVAL MINUTE &
DATE:**

Approved at CAMEC
December 18, 2019

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
Mailey, Shane	VP TRANSMISSION		VP Transmission	2019/12/12
Penner, Glenn	DIRECTOR TRANSMISSION CONST & LINE MTCE		Director - Trans Const & Line Mtc	2019/12/11
Neufeld, Gerald	DIRECTOR TRANSMISSION PLANNING & DESIGN		Director - Trans Planning & Design	2019/12/11
Neufeld, Maria	TRANSMISSION ASSET MANAGEMENT DEPT MGR		Transmission Asset Management	2019/12/11
Swatek, David	SYSTEM PLANNING DEPARTMENT MANAGER		System Planning	2019/12/11
Adamkowicz, Mark	TRANSMISSION PROJECTS DEPARTMENT MGR		Transmission Project Management	2019/12/11
Toews, Kurtis	SENIOR PLANNING ENGINEER		System Planning	2019/12/10
Allan, Patrick	SECTION HEAD		Transmission Project Management	2019/12/10
Mackin, Amna	PROJECT ENGINEER		Transmission Project Management	2019/12/10
Long, Krista	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2019/12/10
Nguyen, Ty	PROJECT OFFICER		Transmission Project Management	2019/12/10
Lee, Steven	STAFF OFFICER	On behalf Of Bell, Christine (cebell).	Transmission Project Management	2019/08/08

CAPITAL INVESTMENT MASTER DATA

RESPONSIBLE OPERATING/CORPORATE GROUP:	Transmission	REQUESTING OPERATING/CORPORATE GROUP:	Transmission
RESPONSIBLE DIVISION:	Transmission Construction & Line Mtce	REQUESTING DIVISION:	Transmission Planning & Design
RESPONSIBLE DEPARTMENT:	Transmission Projects Department	ISD: (YYYY/MM/DD)	2020/11/04
I.M. NODE NUMBER:	2.1.30.15.02.93	W.B.S. NUMBERS:	P:32669
C55 INVESTMENT CODE:	22686		
SAP PROJECT TYPE:	23 - BOC-Corporate Asset Mgmt Exec Committee	C55 INVESTMENT SUB-CATEGORY:	Shell
CORPORATE INVESTMENT CATEGORIES:	(Level 1) C1 / Capacity & Growth (Level 2) CF / System Load Capacity		

CONTACTS			
PREPARED BY:	Nguyen, Ty PROJECT OFFICER 52710	REQUESTOR:	Kurtis Toews, System Planning Department
PROJECT MANAGER:	Mackin, Amna PROJECT ENGINEER 52710		

MANITOBA HYDRO CAPITAL INVESTMENT CONCEPT Portage Area Capacity Enhancement

RECOMMENDATION

Approve \$1.4 million for scope development of the Portage Area Capacity Enhancement Project. The project will enhance reliability of the Portage area with the addition of a new station and transmission line.

SCOPE

The Scope Development Fund will be utilized for the following activities; to be completed in fiscal year 2020/21.

- Structure evaluation and preliminary routing for the new Portage West to Dorsey 230kV Line Project
- Development of conceptual station design, Conceptual Design Report, site survey, and site selection for the new Portage West 230-66kV Station Project
- Finalization of CPD & CBSLD's and development of studies (by System Planning and Distribution Planning), detailed scope of works, detailed cost estimates, detailed schedules and CIJ for the following projects:
 - New Portage West to Dorsey 230kV Line
 - New Portage West 230-66kV Station
 - Dorsey 230kV Line Termination & Breaker Addition
 - 230kV Line P81C Sectionalization
 - New Portage West 66kV Line

BACKGROUND

A System Planning Study (SPD 2019/01) was conducted to examine three major transmission issues in the Portage area, resulting in a Network Reliability Evaluation Study that was conducted to identify possible alternatives to address the issues.

System Planning Study (SPD 2019/01) examined three major transmission issues in the Portage area:

- Insufficient 230/66kV transformation capacity at Portage South station – requires immediate enhancement to prevent single contingency overloads;
- Near-term low voltages at several 115kV and 230kV stations – requires system improvements in the near term (before 2027) to avoid violation of North American Electric Reliability Corporation (NERC) transmission planning criteria; and
- Longer-term low voltage and high thermal loading issues in the area – requires significant enhancements including new transmission stations and lines in the longer-term (approx. 10 year) planning horizon.

Insufficient transformation capacity can result in the need for rotating customer outages or load shed under certain operating conditions. Low voltages could result in poor power quality which may damage customers' electrical equipment or cause manufacturing processes to falter. High thermal loading on transmission lines could result in insufficient line to ground clearance which creates a safety hazard.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

JUSTIFICATION

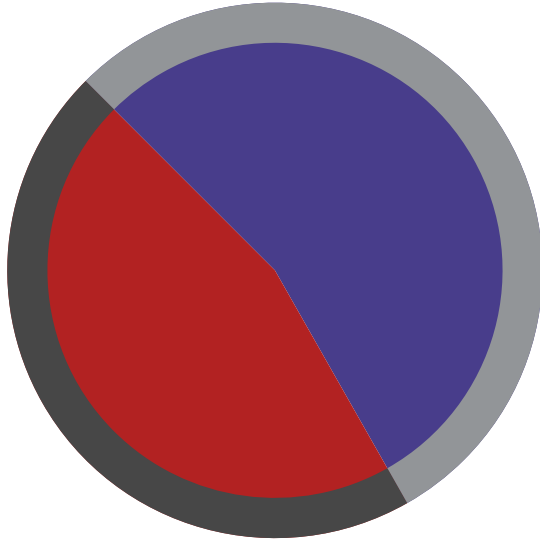
The Portage area is one of the most stressed segments of the transmission system. Above average load growth, new industrial customers, increasing exports to Saskatchewan and deferral of planned transmission projects, are causing a deterioration of reliability to customers in the area.

Various options were assessed of which five viable development plans were identified that would resolve these issues. All five development plans were evaluated using the Corporate Value Framework (CVF). The proposed new

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

Portage West Station and 75km line from Dorsey had the highest Net Value because it had a much higher Transmission Reliability Risk score than the other alternatives and therefore was chosen as the recommended alternative. This alternative is expected to provide relief until approximately 2035 based on current load forecasts, system commitments and committed developments for the area. See the attached CVF Alternative Analysis Summary report for additional information.

CORPORATE VALUE FRAMEWORK



Value Measure	Value Points	% of Value
Transmission Reliability Risk	113,443	54.28%
Total Cost	-95,546	45.72%
Total Value	17,897	
Value/(\$K)	0.19	

OTHER ALTERNATIVES CONSIDERED

The Network Reliability Evaluation Study identified five viable development plans:

- #1: Portage South bank addition and new 70km 230kV line from Dorsey (D83P)
- #2: Portage South bank upgrade and new 70km 230kV line from Dorsey (D83P)
- #3: Portage South to Stanley load transfer upgrades and new 70km 230kV line from Dorsey (D83P)
- #4: New Elm Creek Station and new 30km 230kV line from Dorsey
- #5: New Portage West Station and new 75km 230kV line from Dorsey

All five were evaluated using the Corporate Value Framework (CVF), with development Plan #5 yielding the highest Net Value. See the attached CVF Alternative Analysis Summary report for additional information.

INVESTMENT RISK ANALYSIS

No identified risks.

ESTIMATED COST FLOW

The annual projected cost flows are as follows (in thousands of dollars):

Fiscal Year	Scope Development Funds	Concept Estimate	Total Estimated Investment (Net of Contrib.)
Prev. Actuals	\$0	\$0	\$0
2019/2020	\$640	\$500	\$1,140
2020/2021	\$746	\$1,470	\$2,216
2021/2022	\$0	\$8,000	\$8,000
2022/2023	\$0	\$17,835	\$17,835
2023/2024	\$0	\$37,871	\$37,871
2024/2025+	\$0	\$70,257	\$70,257
Total	\$1,386	\$135,933	\$137,319

IMPACT ON O&A COSTS

This will be determined as part of the CIJ development.

RELATED INVESTMENTS

Winnipeg-Brandon Transmission System Improvements (2.1.30.15.02.7), specifically the 230kV line D83P from Dorsey to Portage South and the associated terminations and communications, currently planned for in-service in April 2025. This project will utilize the geotechnical field data, property acquisitions, Environment Act Licence acquisition activities for the 230kV line D83P

REFERENCE DOCUMENTS

[CVF Alternatives Analysis Summary](#)

C55-CIJ-PROJ

**CAPITAL INVESTMENT JUSTIFICATION
FOR**

Portage Area Capacity Enhancement

Investment Type (Project)

BUDGET:	\$161,574
CONTRIBUTIONS:	\$0
NET BUDGET:	\$161,574
(values listed above are in thousands of dollars)	
CORPORATE VALUE	Value: 107,039
FRAMEWORK SCORE:	Value/\$K: 0.88

DATE PREPARED: 2021-02-19

EC/MHEB APPROVAL MINUTE & DATE: Approved by MHEB on May 13, 2021

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
Midford, Lorne	VP ASSET PLANNING & DELIVERY		VP Asset Planning & Delivery	2021-03-12
Bowen, Dave	DIRECTOR KEEYASK PROJECT		Director - Keeyask Project	2021-03-05
Turner, Hal	DIRECTOR ASSET MANAGEMENT		Director - Asset Management	2021-02-25
Neufeld, Maria	TRANSMISSION ASSET MANAGEMENT DEPT MGR		Transmission Asset Management	2021-02-25
Adamkowicz, Mark	TRANSMISSION PROJECTS DEPARTMENT MGR		Transmission Project Management	2021-02-25
Jacobson, David	ACTING SYSTEM PLANNING DEPT MANAGER		System Planning	2021-02-25
Mackin, Amna	PROJECT ENGINEER		Transmission Project Management	2021-02-25
Toews, Kurtis	SENIOR PLANNING ENGINEER		System Planning	2021-02-19
Long, Krista	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2021-02-19
Mackin, Amna	PROJECT ENGINEER		Transmission Project Management	2021-02-19
Lee, Steven	STAFF OFFICER	On behalf Of Bell, Christine (cebell).	Transmission Project Management	2021-02-19

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Asset Planning & Delivery	REQUESTING OPERATING/CORPORATE GROUP:	Asset Planning & Delivery
RESPONSIBLE DIVISION:	Construction	REQUESTING DIVISION:	Integrated Resource Planning
RESPONSIBLE DEPARTMENT:	Transmission Projects	ISD: (YYYY/MM/DD)	2027/02/28
I.M. NODE NUMBER:	2.1.30.15.02.93	W.B.S. NUMBERS:	P:32669, P:33721, P:33720, P:33719, P:34399, P:34568
C55 INVESTMENT CODE:	22686		
SAP PROJECT TYPE:	23 - BOC-Corporate Asset Mgmt Exec Committee	C55 INVESTMENT SUB-CATEGORY:	Shell
CORPORATE INVESTMENT CATEGORIES:	(Level 1) C1 / Capacity & Growth (Level 2) CF / System Load Capacity		

CONTACTS			
PREPARED BY:	Nguyen, Ty PROJECT OFFICER 52710	REQUESTOR:	Kurtis Toews, System Planning Dept
PROJECT MANAGER:	Mackin, Amna PROJECT ENGINEER 52710		

MANITOBA HYDRO
CAPITAL INVESTMENT JUSTIFICATION
Portage Area Capacity Enhancement

RECOMMENDATION

Approve \$161.6 million for the Portage Area Capacity Enhancement project, which will enhance capacity and reliability in the Portage la Prairie area with the addition of a new station, transmission line and station modifications.

SCOPE

- Build a new 230-66kV station consisting of a four breaker 230kV ring bus, 230-66kV 95MVA transformer bank and one 66kV breaker
- Build a new 230kV transmission line from the new station to existing Dorsey Station
- Sectionalize existing 230kV line P81C into a three terminal line and radial line from the new station to the customer's Roquette Station
- Terminate the new 66kV line at the new station
- Protection changes at Manitoba Hydro's Cornwallis and Portage South Stations and the customer's Roquette Station

BACKGROUND

A System Planning Study (SPD 2019/01) was conducted to examine three major transmission issues in the Portage area, resulting in a Network Reliability Evaluation Study that was conducted to identify possible alternatives to address the issues. The three major transmission issues examined are:

- Insufficient 230-66kV transformation capacity at Portage South station requires immediate enhancement to prevent single contingency overloads;
- Near-term low voltages at several 115kV and 230kV stations requires system improvements in the near-term (before 2027) to avoid violation of North American Electric Reliability Corporation (NERC) transmission planning criteria; and
- Longer-term low voltage and high thermal loading issues in the area requires significant enhancements including new transmission stations and lines in the longer-term (approx. 10 year) planning horizon.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

JUSTIFICATION

The Portage la Prairie area is one of the most stressed segments of the transmission system. Above average load growth, new industrial customers, and increasing exports to Saskatchewan, are causing a deterioration of reliability to customers in the area. As a result of these developments, capacity for connection of large industrial customers in the area is limited.

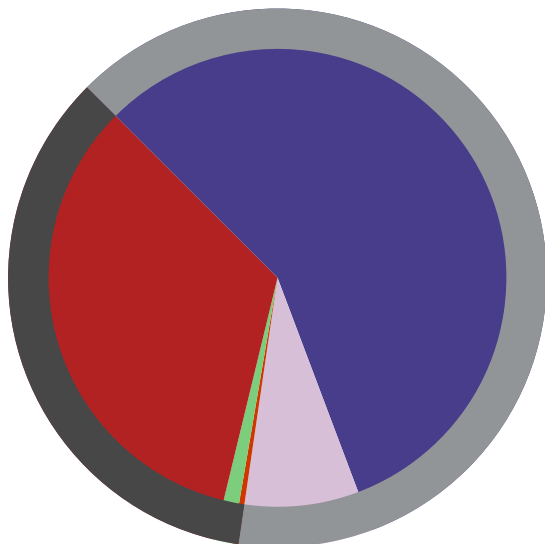
Various options were assessed of which five viable development plans were identified that would resolve these issues. All five development plans were evaluated using the Corporate Value Framework (CVF). The proposed new Portage West Station and line from Dorsey had the highest net value because it had a much higher Transmission Reliability Risk score than the other alternatives and therefore was chosen as the recommended alternative. This

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

alternative is expected to provide relief until approximately 2035 based on current load forecasts, system commitments and committed developments for the area.

Insufficient transformation capacity can result in the need for rotating customer outages or load shed under certain operating conditions. Low voltages could result in poor power quality which might damage customers' electrical equipment or cause manufacturing processes to falter. High thermal loading on transmission lines could mean insufficient line to ground clearance which represents a safety hazard. All issues limit the ability to connect new large loads to the system in the Portage la Prairie area and the southwestern region of Manitoba.

CORPORATE VALUE FRAMEWORK



Value Measure	Value Points	% of Value
Transmission Reliability Risk	205,199	56.76%
Stakeholder Perception Risk	29,075	8.04%
O&M Costs	-1,384	0.38%
Environmental Risk	-3,944	1.09%
Total Cost	-121,908	33.72%
Total Value	107,039	
Value/\$K	0.88	

ANALYSIS OF ALTERNATIVES:

ECONOMIC ANALYSIS		
Discount Rate	For current corporate rates see P911	
	5.5%	

Active Option	NPV Benefits/(Costs)	CVF Score	Value/\$K
Dev Plan #5: New Portage West Station		107,039	0.88

Alternatives at time of CIC	NPV Benefits/(Costs)	CVF Score	Value/\$K
Dev Plan #1: Portage S. Bank Add & D83P		134	0.00
Dev Plan #2: Portage S. Bank U/Gs & D83P		-7,231	(0.10)
Dev Plan #3: Portage S. to Stanley Load Transfer & D83P		-1,376	(0.02)
Dev Plan #4: New Elm Creek Station		-44,476	(0.52)
Dev Plan #5: New Portage West Station		30,652	0.32

INVESTMENT RISK ANALYSIS

Risks that have been identified are as follows:

- Unknown route for 230kV transmission line from -Portage West 230-66kV Station to Dorsey Station. No public engagement activities were executed during the Capital Investment Concept (CIC) phase. Internal routing workshops have been conducted to establish routing options for the purpose of project scoping and estimating. Manitoba Hydro’s final preferred route will be determined following public engagement activities.
- Construction and material estimates are based on current market conditions and may vary at time of tendering.
- Potential increase in transmission line construction costs associated with resequencing of construction activities due to delays in acquiring property and/or permits.
- Potential increase in transmission line construction costs due to need for additional construction matting and/or increased biosecurity requirements.
- Potential increase in transmission line construction and material costs associated with foundation installations due to unknown or unfavourable soil conditions.

The project estimate includes contingency value of \$32 million or approximately 30% of base estimate. This value was developed using a probabilistic method of determining contingency, utilizing a Monte Carlo analysis to identify a 75% probability of underrun (P75).

ESTIMATED COST FLOW

The annual projected cost flows are as follows (in thousands of dollars):

Fiscal Year	Budget	Contributions	Net Budget
Prev. Actuals	\$102	\$0	\$102
2020/2021	\$634	\$0	\$634
2021/2022	\$3,809	\$0	\$3,809
2022/2023	\$9,325	\$0	\$9,325
2023/2024	\$9,615	\$0	\$9,615
2024/2025	\$34,743	\$0	\$34,743
2025/2026+	\$103,346	\$0	\$103,346
Total	\$161,574	\$0	\$161,574

IMPACT ON O&A COSTS

There will be maintenance costs incurred as a result of this project for the station and line.

Per Transmission Line Maintenance and Transmission Projects, maintenance on a line in this region can be estimated at \$1k/km, annually. At this stage, the line is expected to be 85 km long, so maintenance is estimated at \$85k annually.

Per Transmission Operations & Maintenance, maintenance on the station for this project can be estimated at \$10k annually (based on past maintenance costs on a similar station). The station maintenance costs will begin following the station in-service, scheduled for March 2025 (costs begin April 2025).

Once the line is in-service (scheduled for February 2027, costs begin March 2027), these costs will increase to \$10k + \$85k = \$95k.

PROPOSED SCHEDULE

Proposed High Level Schedule:

- Fiscal year 2020 & 2021 for Scope Development
- Fiscal year 2022 to 2023 for environmental licensing and property acquisition
- Fiscal year 2022 to 2025 for detailed designs, drawings and apparatus and material procurements
- Fiscal year 2024 for first year of construction
- Fiscal year 2027 for final year of construction

RELATED INVESTMENTS

Winnipeg-Brandon Transmission System Improvements (2.1.30.15.02.7), specifically the 230kV line D83P from Dorsey to Portage South and the associated terminations and communications, currently planned for in-service in April 2025 will be replaced with the PACE project.

OTHER ALTERNATIVES CONSIDERED

The Network Reliability Evaluation Study identified five viable development plans:

- #1: Portage South bank addition and new 70km 230kV line from Dorsey (D83P)
- #2: Portage South bank upgrade and new 70km 230kV line from Dorsey (D83P)
- #3: Portage South to Stanley load transfer upgrades and new 70km 230kV line from Dorsey (D83P)
- #4: New Elm Creek Station and new 30km 230kV line from Dorsey
- #5: New Portage West Station and new 230kV line from Dorsey

All five were evaluated using the Corporate Value Framework (CVF), with development Plan #5 yielding the highest Net Value.

REFERENCE DOCUMENTS

[22686_CIC_Brandon Portage Area Reliabili.docx](#)

[Cost Element Detail_Portage Area Capacity Enhancement.xlsx](#)

C55-CIJ-PROJ

CAPITAL INVESTMENT JUSTIFICATION FOR

De Salaberry - Letellier 230 kV Transmis

Investment Type (Project)

BUDGET:	\$67,950
CONTRIBUTIONS:	\$0
NET BUDGET:	\$67,950
(values listed above are in thousands of dollars)	
CORPORATE VALUE	Value: 87,337
FRAMEWORK SCORE:	Value/\$K: 1.66

DATE PREPARED: 2018/01/18

**EC/MHEB APPROVAL MINUTE &
DATE:**

Approved by MHEB
March 16, 2018
Minute # 888.06

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
MAILEY, SHANE	VP TRANSMISSION		VP Transmission	2018/01/22
NEUFELD, GERALD	DIRECTOR TRANSMISSION PLANNING & DESIGN		Director - Trans Planning & Design	2018/01/22
PENNER, GLENN	DIRECTOR TRANSMISSION CONST & LINE MTCE		Director - Trans Const & Line Mtc	2018/01/19
ADAMKOWICZ, MARK	TRANSMISSION PROJECTS DEPARTMENT MGR		Transmission Project Management	2018/01/19
ALLAN, PATRICK	SECTION HEAD		Transmission Project Management	2018/01/19
JACOBSON, DAVID	INTERCONNECTION-GRID SUPPLY SECTION HEAD	On behalf Of SWATEK, DAVID (drswatek).	System Planning	2018/01/19
YANG, RAE	PROFESSIONAL ENGINEER		System Planning	2018/01/19
Perrault, Kristen	FINANCIAL SERVICES SUPERVISOR	On behalf Of LONG, KRISTA (kllong).	Financial Advisory Services	2018/01/18
COLLET, LUC	PROJECT OFFICER		Transmission Project Management	2018/01/18
BELL, CHRISTINE	TRANS CAPITAL PORTFOLIO ACCOUNTANT		Transmission Project Management	2018/01/18

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Transmission	REQUESTING OPERATING/CORPORATE GROUP:	Transmission
RESPONSIBLE DIVISION:	Transmission Construction & Line Mtce	REQUESTING DIVISION:	Transmission Planning & Design
RESPONSIBLE DEPARTMENT:	Transmission Projects Department	ISD: (YYYY/MM/DD)	2021/10/31
I.M. NODE NUMBER:	2.1.30.15.02.81	W.B.S. NUMBERS:	P:17033, P:17034, P:17330
C55 INVESTMENT CODE:	13835		
SAP PROJECT TYPE:	22 - BOC-Executive Committee	C55 INVESTMENT SUB-CATEGORY:	Shell
CORPORATE INVESTMENT CATEGORIES:	(Level 1) C1 / Capacity & Growth (Level 2) CF / System Load Capacity		

CONTACTS			
PREPARED BY:	YANG, RAE PROFESSIONAL ENGINEER 52080	REQUESTOR:	Rae Yang, System Planning Dept.
PROJECT MANAGER:	COLLET, LUC PROJECT OFFICER 52710		

MANITOBA HYDRO
CAPITAL INVESTMENT JUSTIFICATION
De Salaberry - Letellier 230 kV Transmis

RECOMMENDATION

Design and build a new 230kV transmission line from the proposed new De Salaberry Station to the Letellier Station, including associated terminations and communications to improve the power network in Southern Manitoba and is required to ensure reliability of supply and ensure loads can be served. The total net costs are estimated at \$67,941,000 with an in-service date of October 2021.

SCOPE

The scope of the project is the construction of 79km of overhead 230kV transmission line, which will be terminating at Letellier and the De Salaberry East Station and will include the associated revisions to the communication systems.

BACKGROUND

The existing southern Manitoba power system is prone to possible line overloading and low voltage situations which may affect our ability to serve customer load and limit export capability.

The 115 kV system south of Winnipeg is heavily loaded, subject to severe low voltage and lines are in need of repair or replacement.

In addition, electrical loads in southern Manitoba are growing faster than the provincial average.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

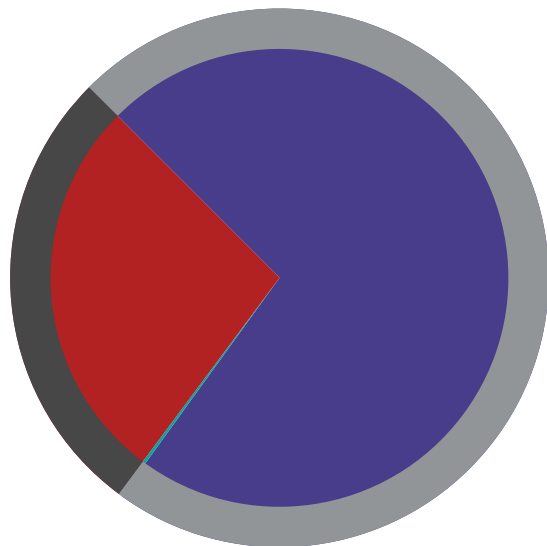
JUSTIFICATION

Following the construction of the St. Vital to De Salaberry transmission line and De Salaberry East Station, a 230 kV transmission line from De Salaberry to Letellier is the final component in the plan to improve the power network in southern Manitoba.

The following benefits would be realized by building the De Salaberry to Letellier line:

- Provides a second/redundant 230 kV supply to De Salaberry East Station which will eliminate the risk of a total loss of load in the event that St. Vital - De Salaberry 230 kV transmission line V78G trips.
- Provides security of supply to the Letellier/Stanley area to allow transfer of load off the 110 kV system to the 230 kV system at Stanley Station which will ensure we are able to meet load serving obligations in the Hanover, St. Vital, Richer, Letellier, Rosenfeld, Morden Corner, Stanley and De Salaberry areas.
- In addition, without proceeding with the De Salaberry to Letellier transmission line, Manitoba Hydro could experience significant risk of NERC & voltage criteria violations.
- Allows for the salvage of 115kV transmission lines YF11, YM31 and VJ50 which are currently near their end of life and otherwise would need to be rebuilt (see alternative options not being recommended below).

CORPORATE VALUE FRAMEWORK



Value Measure	Value Points	% of Value
Transmission Reliability Risk	139,541	72.46%
Export Transfer Capacity Risk	409	0.21%
Total Cost	-52,614	27.32%
Total Value	87,337	
Value/\$K	1.66	

ANALYSIS OF ALTERNATIVES:

ECONOMIC ANALYSIS		
Discount Rate	For current corporate rates see P911 6.25%	

Active Option	NPV Benefits/(Costs)	CVF Score	Value/\$K
Preferred		87,337	1.66

Other Alternatives	NPV Benefits/(Costs)	CVF Score	Value/\$K

INVESTMENT RISK ANALYSIS
<p>Risks that have been Identified are as follows:</p> <ul style="list-style-type: none"> •Construction estimates are based on current market conditions and could fluctuate at the time of tendering depending on future market conditions. •Property acquisition delays could result in delays to the construction work, forcing more work to be done during warmer months and increasing the requirements for biosecurity efforts, thus increasing costs. •Foundation installation difficulties due to unknown or unfavorable soil conditions. <p>For this project a probabilistic method of contingency development was used, which utilizes Monte Carlo analysis to determine a probability of underrun for the project budget. The current estimate includes contingency totaling \$10.0 million, which is 17% of the remaining base expenditures and is based on a probability of underrun of 75% (P75).</p>

ESTIMATED COST FLOW			
The annual projected cost flows are as follows (in thousands of dollars):			
Fiscal Year	Budget	Contributions	Net Budget
Prev. Actuals	\$3,103	\$0	\$3,103
2017/2018	\$1,385	\$0	\$1,385
2018/2019	\$4,629	\$0	\$4,629
2019/2020	\$13,667	\$0	\$13,667
2020/2021	\$16,783	\$0	\$16,783
2021/2022	\$28,378	\$0	\$28,378
2022/2023+	\$3	\$0	\$3
Total	\$67,950	\$0	\$67,950

IMPACT ON O&A COSTS

Since this project will enable (see Related Investments) transfer of load from the 115 kV system (Morden Corner, Rosenfeld and Hanover Stations) to the 230 kV system (Stanley and future De Salaberry Stations) the 115 kV stations and 115 kV lines YF11, YM31 and VJ50 could eventually be salvaged resulting in O & A costs remaining virtually unchanged.

RECOMMENDED OPTION

Construct a new 230 kV transmission line from the proposed new De Salaberry Station to the Letellier Station, including associated terminations and communications.

PROPOSED SCHEDULE

Preliminary design for the De Salaberry to Letellier Transmission Line is currently underway.

- Detail design from January 2018 to September 2019
- Procurement of all transmission line materials from October 2018 to February 2020
- Construction from July 2020 to August 2021
- Commissioning from August 2021 to October 2021
- In-service date October 2021

RELATED INVESTMENTS

- Stanley Station 230/66kV permanent transformer addition
- Stanley Area 115kV Load Migration To 230kV Supply Network Phase III - Third Bank Addition
- St. Vital to De Salaberry 230kV transmission line and De Salaberry East Station

OTHER ALTERNATIVES CONSIDERED

System Planning report SPD 2008/15 considered several options:

Option 1: 230 kV line from Letellier to St. Vital

Option 2: 230 kV line from Letellier to Riel

Option 3: 230 kV line from Letellier to Richer

Option 4: Rebuild 230 kV lines Y51L (LaVerendrye - Letellier) and S60L (Letellier - St. Leon)

REFERENCE DOCUMENTS

[SPD 2008-15 Letellier-St. Vital New 230 kV Line.pdf](#)

[SPD 2012-15 Stanley Area 115kV Load Migration to 230kV Supply Network.pdf](#)

[SPD 2014-02 Steinbach Area 230-66.pdf](#)

**CAPITAL INVESTMENT JUSTIFICATION ADDENDUM
FOR**

**De Salaberry - Letellier 230 kV Transmission Line
Investment Type (Project)
Addendum Number 1**

	<u>PREVIOUSLY APPROVED</u>	<u>REVISED</u>	<u>INCREASE/ (DECREASE)</u>
BUDGET:	\$67,950	\$73,812	\$5,862
CONTRIBUTIONS:	\$0	\$0	\$0
NET BUDGET:	\$67,950	\$73,812	\$5,862
(values listed above are in thousands of dollars)			
CORPORATE VALUE	Value: 150,121	Value: 109,250	
FRAMEWORK SCORE:	Value/\$K: 0.00	Value/\$K: 1.93	

Approved by Jay Grewal,
President & CEO
November 26, 2021

**EC/MHEB APPROVAL MINUTE &
DATE:**

DATE PREPARED: 2021-09-27

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
Midford, Lorne	VP ASSET PLANNING & DELIVERY		VP Asset Planning & Delivery	2021-10-06
Turner, Hal	DIRECTOR ASSET MANAGEMENT		Director - Asset Management	2021-10-06
Halayko, Krista	ASSET MGMT STRATEGY & PLANNING DEPT MGR		Asset Management Strategy & Planning	2021-10-06
Adamkowicz, Mark	TRANS & DIST PROJECTS DEPT MANAGER		Transmission & Distribution Projects	2021-10-06
Braid, Kristin	GRID INFRASTRUCTURE PLANNING DEPT MGR		Grid Infrastructure Planning	2021-10-06
Ewanchuk, Calvin	PROFESSIONAL ENGINEER		Grid Infrastructure Planning	2021-10-06
Long, Krista	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2021-10-06
Woo, Michelle	PROJECT ENGINEER		Transmission & Distribution Projects	2021-10-06
Bell, Christine	PORTFOLIO ACCOUNTANT		Asset Management Strategy & Planning	2021-09-27

ADDENDUM NUMBER	DATE	REVISION (Summary of change)
Original CPJ	March 16, 2018	New item.

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Asset Planning & Delivery	REQUESTING OPERATING/CORPORATE GROUP:	Asset Planning & Delivery
RESPONSIBLE DIVISION:	Project Management	REQUESTING DIVISION:	Integrated Resource Planning
RESPONSIBLE DEPARTMENT:	Transmission & Distribution Projects	ISD: (YYYY/MM/DD)	2025/01/31
I.M. NODE NUMBER:	2.1.30.15.02.81	W.B.S. NUMBERS:	P:17033, P:17034, P:17330, P:34275, P:34274, P:34972
C55 INVESTMENT CODE:	13835		
SAP PROJECT TYPE:	22 - BOC-Executive Committee	C55 INVESTMENT SUB-CATEGORY:	Shell
CORPORATE INVESTMENT CATEGORIZATION:	(Level 1) C1 / Capacity & Growth (Level 2) CF / System Load Capacity		

CONTACTS			
PREPARED BY:	Woo, Michelle PROJECT ENGINEER 52710	REQUESTOR:	Calvin Ewanchuk, System Planning Dept
PROJECT MANAGER:	Woo, Michelle PROJECT ENGINEER 52710		

MANITOBA HYDRO
CAPITAL INVESTMENT JUSTIFICATION ADDENDUM
De Salaberry - Letellier 230 kV Transmission Line

RECOMMENDATION

Approve an increase of \$5.9M from a previously approved amount of \$67.9M due to adding the salvages of Hanover Station and a portion of 115kV transmission line VJ50, increased contract pricing and a reduction of contingency.

SCOPE

This CIJA includes the scope addition to salvage both the existing 115-66 kV Hanover Station and 11 km of 115 kV transmission line VJ50 (St. Vital to Hanover). These items were previously approved under the St. Vital - De Salaberry 230 kV Transmission Line and De Salaberry East Station project [2.1.30.15.02.83].

BACKGROUND

Following the construction of the St. Vital to De Salaberry transmission line and De Salaberry East Station, a 230 kV transmission line from De Salaberry to Letellier (G79L) is the final component to improve the power network in southern Manitoba.

Hanover Station was considered inadequate to supply the growing Steinbach area load. With the construction of the De Salaberry East Station, the 230kV transmission line, and associated 66kV work, the 66kV system will bypass Hanover Station isolating the station. Hanover Station and the portion of VJ50 between Randolph and Hanover is to be decommissioned and salvaged.

The salvage scope has been deferred to coincide with the timing of the final 230kV transmission line (G79L).

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

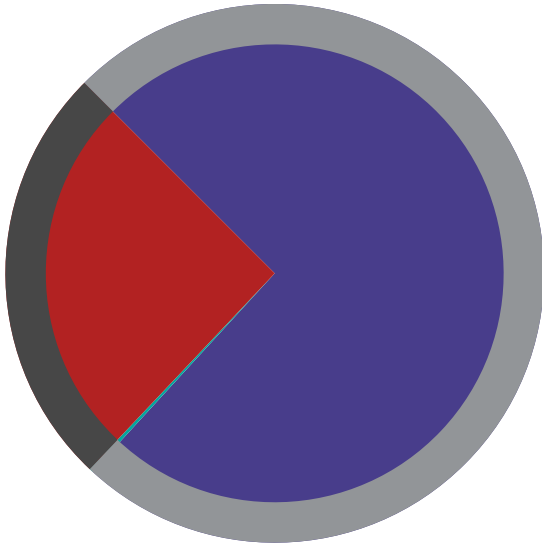
JUSTIFICATION

This CIJA reflects the change of scope, revised budget and in-service date.

The project budget has increased due to the following:

- An increase in scope to include the salvage of the existing 115-66 kV Hanover Station and 11 km of 115 kV transmission line VJ50
- An increase in estimated transmission line construction costs based on tender amounts
- A decrease in contingency based on a Monte Carlo analysis of remaining expenditures

CORPORATE VALUE FRAMEWORK (REVISED)



Value Measure	Value Points	% of Value
Transmission Reliability Risk	165,411	74.33%
Export Transfer Capacity Risk	485	0.22%
Total Cost	-56,647	25.45%
Total Value	109,250	
Value/ŞK	1.93	

ANALYSIS OF ALTERNATIVES:

ECONOMIC ANALYSIS	
Discount Rate	For current corporate rates see P911 5.5%

Active Option	NPV Benefits/(Costs)	CVF Score	Value/\$K
Preferred		109,250	1.93

INVESTMENT RISK ANALYSIS
<p>Risks that have been Identified are as follows:</p> <ul style="list-style-type: none"> • Property acquisition delays or inclement weather could result in delays to the construction work, forcing more work to be done during warmer months and increasing the requirements for biosecurity efforts, thus increasing costs. • Foundation installation difficulties due to unknown or unfavorable soil conditions. • Increased costs for Hanover salvage due to potential soil remediation and asbestos removal efforts. <p>Deferral or not salvaging Hanover Station and the portion of VJ50 presents a risk to public perception, raises safety concerns and is a potential liability for Manitoba Hydro. Salvaging Hanover Station also addresses environmental legislation that requires all in-use/in-service assets with PCB values greater than or equal to 50 ppm to be eliminated by December 31, 2025.</p> <p>For this project a probabilistic method of contingency development was used, which utilizes Monte Carlo analysis to determine a probability of underrun for the project budget. The current estimate includes contingency totaling \$6.3 million, which is 13% of the remaining base expenditures and is based on a probability of underrun of 75% (P75).</p>

MANITOBA HYDRO
CAPITAL INVESTMENT JUSTIFICATION ADDENDUM
De Salaberry - Letellier 230 kV Transmission Line

ESTIMATED COST FLOW

The annual projected cost flows are as follows (in thousands of dollars):

	PREVIOUSLY APPROVED			PROPOSED			INCREASE / (DECREASE)		
Fiscal Year	Budget	Contributions	Net Budget	Budget	Contributions	Net Budget	Budget	Contributions	Net Budget
Prev. Actuals	\$39,568	\$0	\$39,568	\$13,744	\$0	\$13,744	(\$25,824)	\$0	(\$25,824)
2021/2022	\$28,378	\$0	\$28,378	\$37,119	\$0	\$37,119	\$8,740	\$0	\$8,740
2022/2023	\$3	\$0	\$3	\$12,856	\$0	\$12,856	\$12,853	\$0	\$12,853
2023/2024	\$0	\$0	\$0	\$8,445	\$0	\$8,445	\$8,445	\$0	\$8,445
2024/2025	\$0	\$0	\$0	\$1,635	\$0	\$1,635	\$1,635	\$0	\$1,635
2025/2026	\$0	\$0	\$0	\$13	\$0	\$13	\$13	\$0	\$13
2026/2027+	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Total	\$67,950	\$0	\$67,950	\$73,812	\$0	\$73,812	\$5,862	\$0	\$5,862

IMPACT ON O&A COSTS

Salvaging Hanover Station and a portion of VJ50 would decrease O & A costs a minor amount.

MANITOBA HYDRO
CAPITAL INVESTMENT JUSTIFICATION ADDENDUM
De Salaberry - Letellier 230 kV Transmission Line

PROPOSED SCHEDULE

The project schedule was delayed one year due to the re-allocation of resources to support other corporate project priorities in 2019. Station and transmission line in-service has been re-scheduled to October 31, 2022.

Design and material deliveries for the project are currently underway.

- Construction from July 2021 to September 2022
- Commissioning from September 2022 to October 2022
- In-service date October 31, 2022
- Salvage completion of VJ50 November 2024
- Salvage completion of Hanover Station January 2025

RELATED INVESTMENTS

- Stanley Station 230/66kV permanent transformer addition
- Stanley Area 115kV Load Migration To 230kV Supply Network Phase III - Third Bank Addition
- St. Vital to De Salaberry 230kV transmission line and De Salaberry East Station

OTHER ALTERNATIVES CONSIDERED

System Planning report SPD 2008/15 considered several options:

Option 1: 230 kV line from Letellier to St. Vital

Option 2: 230 kV line from Letellier to Riel

Option 3: 230 kV line from Letellier to Richer

Option 4: Rebuild 230 kV lines Y51L (LaVerendrye - Letellier) and S60L (Letellier - St. Leon)

REFERENCE DOCUMENTS

[SPD 2008-15 Letellier-St. Vital New 230 kV Line.pdf](#)

[SPD 2012-15 Stanley Area 115kV Load Migration to 230kV Supply Network.pdf](#)

[SPD 2014-02 Steinbach Area 230-66.pdf](#)

[13835 CIJ De Salaberry - Letellier 230 k.docx](#)

[Cost Element Detail DeSalaberry - Letellier 230 kV Trans Line](#)

D1876(A)

**CAPITAL PROJECT JUSTIFICATION
FOR
LAVENDERDYE - ST. VITAL NEW 230KV
TRANSMISSION LINE & BREAKERS REPLACEMENT**

REVIEWED BY:
(Owning Dept Manager)
David Jacobs - June 14, 2013
for Ron Moberg

NOTED BY:
(if applicable)
Coordinating Division: *A. Minsky June 14, 2013*
Constructing Division:
Designing Division:

BUDGET \$: (Total Net Cost)	\$32,752,000
START DATE: (1 st Cost Flow)	2010 07
IN-SERVICE DATE: (Indicate "Multi" if more than 1)	Multi - 2017 07
RISK MATRIX/ BUSINESS CASE TIER:	Tier 1 (1540 points)
INVESTMENT REASONS:	Capacity Enhancement (66%) Employee & Public Safety (27%) Aging Infrastructure (7%)

Financial: *Shiewerburg 2013.06.06*

RECOMMENDED FOR IMPLEMENTATION:

Owning Div. Manager: *R. Yang June 17 / 13*

Business Unit V.P.: *R. Yang / T.E. Tyndal June 20, 2013*

OWNING DIVISION: TRANSMISSION PLANNING & DESIGN

IML NODE NUMBER: 1.1.2.3.48.1

W.B.S. NUMBERS: P:15253, P:15257, P:15258, P:15260, P:17331

MAJOR ITEM DOMESTIC ITEM

PREPARED BY: R. Yang, Project Owner *R.Y. 2013/06/1*
B. Saunders, Project Manager

DATE PREPARED: 2013 05 30 *B.S. 2013/06/06*

PRIMARY JUSTIFICATION:
Indicate key project driver(s):

<input checked="" type="checkbox"/> Safety	<input type="checkbox"/> Customer Service
<input type="checkbox"/> System Supply	<input type="checkbox"/> Efficiency
<input checked="" type="checkbox"/> System Reliability	<input type="checkbox"/> Environmental

NERC COMPLIANCE * YES NO

* Determine if the project requires compliance with North American Electric Reliability Corporation (NERC) CIP Cyber Security Standards.

REPORT NUMBER: SPD 2008/06 & SPD 2008/20

FILE NUMBER (Optional):

**MANITOBA HYDRO
CAPITAL PROJECT JUSTIFICATION**

Project Name

Laverendrye – St. Vital New 230kV Transmission Line and Breakers Replacement

Recommendation

Establish a new Major complex for installation of a new 230kV transmission line from Laverendrye Station to St. Vital Station plus associated terminations and modifications, and replacement of 115kV and 230kV breakers at Laverendrye Station. The total net cost is estimated at \$32,752,000 for an in-service of February 2017 for the new line, a staged in-service from November 2015 to November 2016 for replacement of the 230kV breakers, and a staged in-service from February 2015 to July 2017 for replacement of the 115kV breakers.

Project Scope

The detailed scope for the complex is as follows:

- a) Environmental licensing, and design and installation of 37km of 230kV overhead transmission line from Laverendrye to St. Vital Stations. The total Gross cost is estimated at \$16,257,000 and the planned in-service is February 2017 (P:15260). Note that acquisition of property rights for the Right Of Way are included elsewhere, namely under the Dorsey-Riel South Loop ROW Property Requirements non-blanket project under Transmission Planning & Design's domestic program.
- b) Termination at Laverendrye Station of the new 230kV transmission line and replacement of five 230kV breakers. Work includes installation of one 230kV breaker and its associated equipment in breaker position R12, revisions to the protection system to accommodate the new line, and replacement of the five 230kV breakers in positions R9, R10, R11, R21, and R22. The total Gross cost is estimated at \$4,985,000 with the line termination going into service in February 2017 and the breakers going into service in stages, from November 2015 to November 2016 (P:15258).
- c) Termination at St. Vital Station of the new 230kV transmission line. Work includes installation of one 230kV breaker and its associated equipment in breaker position R11, and revisions to the protection system to accommodate the new line. The total Gross cost is estimated at \$1,918,000 and the planned in-service is February 2017 (P:15257).
- d) Revisions to the communications systems at Laverendrye and St. Vital Stations to accommodate the new transmission line. The total Gross cost is estimated at \$355,000 and the planned in-service is February 2017 (P:17331).
- e) Replacement at Laverendrye Station of ten 115kV breakers: the 115kV bus tie breaker, and the 115kV breakers of lines YM31 (to Morden), YT10 (to Treherne), YF11 (to Rosenfeld), YX47 and YX48 (to Ft. Garry-Mohawk), YV5 (to St. Vital), YH33 (to Harrow), KY32 (from Kirkfield) and RY7 (from Rosser). Work includes the installation of a hybrid Station Automation System (SAS) in parallel with the existing RTU. The total Gross cost is estimated at \$6,319,000 with the breakers going into service in stages, from February 2015 to July 2017 (P:15253).

The total Gross estimate for the above is \$29,834,000. With forecast escalation estimated at \$1,457,000 and capitalized interest estimated at \$1,461,000, the Total Net Cost is \$32,752,000.

Background

The reliability of the 230kV network in the Winnipeg area has a significant impact on the successful operation of the Manitoba Hydro power system. Given that this network is not presently a 230kV ring, under certain severe outages the network would be broken into segments with some stations becoming isolated, resulting in difficulties operating the system and possible black-outs.

This 230kV network is presently fed by the Northern Collector System via Bipoles I and II, and will be supplied additionally by Bipole III when it goes into service in 2017. Completion of Bipole III and the Riel Converter Station will increase the strength of the Manitoba Hydro system which will have implications on the station fault level and the ability of aged circuit breakers to operate safely at Laverdnye Station (along with several other stations that are in close proximity to Riel).

JUSTIFICATION—BUSINESS CASE ANALYSIS (SUMMARY):

Justification and Link to Corporate/Business Unit Goals

System Planning’s report SPD 2008/06^[1] recommends installation of a new line between Laverdnye Station and St. Vital Station in order to upgrade the 230kV network in this area to a 230kV ring, which will improve the network’s reliability as well as meet load growth in southern Manitoba. System Planning’s report SPD 2008/20^[2] recommends replacement of ten 115kV and five 230kV breakers at Laverdnye Station, to address circuit breakers that are under-rated for the increase in available fault current that will occur upon completion of Bipole III and the Riel Converter Station. These 15 breakers currently exceed 95% of their Maximum Symmetrical Current Interrupting Rating. Fault current levels that exceed a circuit breaker’s interrupt capability can result in catastrophic failure of the breaker, possibly causing serious injury to employees and/or the public. The 230kV breakers require replacement some time after the Riel 230/500kV Station is established and before the Laverdnye – St. Vital 230kV Line is completed. The 115kV breakers require replacement prior to completion of Bipole III and the Riel Converter Station (regardless of whether that Station will use Line Commutated Converters or Voltage Source Converters).

The referenced reports recommended that installation of the new line and replacement of the breakers take place to coincide with the in-service of Bipole III and the Riel Converter Station, or 2017. However, System Planning report SPD 2010/01^[3] justified advancement of the new line and the 230kV breaker replacements to 2014, in association with Riel Sectionalization. The advancement was recommended because the current firm export level of the Manitoba-US interconnection during an outage of the MH-US 500kV line cannot be maintained under all conditions after Riel Sectionalization in 2014, due mainly to growing load in the Winnipeg area. Two alternatives to having this new line in place would be to reduce the prior outage transfer level on the Dorsey-Forbes 500kV line from 675 MW to as low as 0 MW, or to upgrade lines R23R (Rosser-Ridgeway) and D36R (Dorsey-Ridgeway) at an estimated cost of \$18,500,000 in order to reinforce the system in the Winnipeg area (which would maintain the 675 MW level). A reduction in the Manitoba-US interconnection prior outage transfer capability has two implications:

- Would result in a significant increase in Manitoba Hydro’s share in the contingency reserve of the Midwest Contingency Reserve Sharing Group. An increase in the contingency reserve carries a huge financial risk to the Corporation and may force us to re-open the Contingency Reserve Sharing Agreement with MISO.
- Could result in significant loss of export sales revenues.

Replacement of the 115kV breakers does not need to be advanced; their requirement remains tied to completion of Bipole III and the Riel Converter Station in 2017.

JUSTIFICATION—BUSINESS CASE ANALYSIS (SUMMARY):

Justification and Link to Corporate/Business Unit Goals

Notwithstanding the recommendations to advance this work, it has been determined that it will not be possible to place the Laverendrye to St. Vital line in service for 2014. Similarly, it would not be possible to upgrade R23R and D36R for 2014. Although the original recommendations were approved in 2008/09 and the recommendation for advancement was approved in 2009/10, we were unable to start planning for this project any earlier due to other high-priority work that involved the same internal resources as those needed for this project. In addition, the overall timeline for the transmission line portion of the project is 53 months. This is based on needing 18 months for the environmental licensing process and 35 months for design, material procurement, construction and commissioning of the line and its terminations. It should be noted that preliminary environmental licensing activities are already underway, since a portion of this new line will share the same corridor as a portion of the new Letellier – St. Vital 230KV line, which was approved in 2012/13. Commencing the licensing activities for the Laverendrye line at the same time as the Letellier line was done in order to achieve work synergies as well as in recognition of the merits of acknowledging the combined usage of this right-of-way when holding consultations with the community and licensing agencies.

Given that it's been determined the project cannot be completed any earlier than 2017, the potential cost of increased contingency reserve and potential loss in export revenue between the years of 2014 and 2017 is considered a risk associated with this project. In addition, should the 2017 in-service date not be met there will be ongoing additional costs associated with the increased contingency reserve and loss in export sales, which are estimated as follows:

- The estimated cost of increased contingency reserve could range from a low of \$7 million/year to a high of \$132 million/year.
- Loss of export revenue could range from a low of \$4 million/year to a high of \$5.3 million/year (based on \$45/MWh).

In the event the 2017 in-service date cannot be met, the alternative of reconductoring lines R23R and D36R would have to be pursued.

Capital Investment Categorization – new 230KV line and associated terminations and communications:

<u>Driver</u>	<u>Category</u>	<u>Sub-category</u>	<u>Split</u>	<u>Amount</u>
Reliability: Load-related	Capacity Enhancement	various	60%	\$13,144,000
Reliability: Import/Export- related	Capacity Enhancement	various	40%	\$ 8,149,000
			100%	<u>\$21,293,000</u>

Capital Investment Categorization – breaker replacements:

<u>Driver</u>	<u>Category</u>	<u>Sub-category</u>	<u>Split</u>	<u>Amount</u>
Safety	Employee Safety	Asset Sustainment	40%	\$ 4,573,000
Safety	Public Safety	Asset Sustainment	40%	\$ 4,573,000
Reliability: Outage-related	Aging Infrastructure	Asset Sustainment	20%	\$ 2,313,000
				<u>\$11,459,000</u>

ANALYSIS OF ALTERNATIVES:

Economic Analysis		
Discount Rate	6.10%	For current corporate rates see G911
Recommended Option		
As per Recommendation above.		
		NPV Benefits (Costs)
		(\$22,450,000)

Other Alternatives Considered		NPV Benefits (Costs)
Alternative 2: Laverendrye - Riel 230kV Line & Breakers Replacement		(\$24,115,000)
a)	Construct 41.4 km of 230kV overhead line from Laverendrye to Riel. Terminate the new line at Laverendrye Station with one 230kV breaker and its associated equipment in position R12. Terminate the new line at Riel Station with one 230kV breaker and its associated equipment in breaker position 35. Revise protection and communications systems to accommodate the new line. ISD is 2014 04 30 and Total NPV is (\$16,315,000).	
b)	Replace 230kV breakers in positions R9, R10, R11, R21 and R22 at Laverendrye Station. ISD is 2014 04 30 and Total NPV is (\$3,300,000).	
c)	Replace 115kV breaker of bus tie and 115kV breakers of lines YM31, YT10, YF11, YX48, YX47, YV5, YH33, KY32 and RY7 at Laverendrye Station. ISD is 2017 10 31 and Total NPV is (\$4,500,000).	

Project Risk Analysis

A total of \$2,679,000 of Contingency has been included in the project estimate, which is approximately 10% of the base expenditures. This majority of this Contingency is in association with the following:

- Laverendrye – St. Vital New 230kV Line (\$1,241,000 or approximately 8% of the base, P:15260):
 - Potential scheduling delays for land acquisition.
 - Potential scheduling delays due to large volume of transmission line work and contractor availability.
 - Potential additional effort in association with environmental licensing and monitoring regarding Section 35 of the Constitution Act, 1982.
 - Weather-related cost increases due to difficulty accessing the site or colder than normal conditions.
- Laverendrye 115kV Breaker Replacements (\$595,000 or approximately 10% of the base, P:15253):
 - Potential for civil construction or electrical construction taking place in the winter months.
 - Potential increase for additional requirements for Structure/Equipment & Grounding design, if existing drawings are inaccurate or need updates.
 - Potential cost increase for additional efforts required by junior design staff.
 - Potential scope increase, if the existing piles need upgrading (base estimate assumes they don't).
- Laverendrye Station - New 230kV Line Term (\$556,000 or approximately 13% of the base, P:15258):
 - Potential for civil construction or electrical construction taking place in the winter months.
 - Potential increase for additional requirements for drawing coordination due to the amount of work planned at this station and if existing drawings are inaccurate or need updates.
 - Potential cost increase for additional efforts required by junior design staff.
 - Potential cost increase for ground study and possible ground grid upgrades.

Project Risk Analysis

In addition to the schedule-related risks noted above, there are two other factors which could jeopardize the February 2017 in-service date for the new line. One is the unusually large volume of transmission line work taking place in the province over the next several years (e.g. Bipole III 500kV Transmission Line, Dorsey to Portage 230kV Transmission Line, Pine Falls to Manigotagan Corner 115kV Transmission Line, Keeyask 138kV Tap for construction power, and the aforementioned Letellier to St. Vital 230kV Line). Availability of both internal and external resources could prove challenging as a result. The second is the unusually large volume of work planned at Laverendrye Station between now and 2018 (approved projects Transmission Line Protection & Teleprotection, 13.2kV Shunt Reactor Replacements and Waverley West 66kV Supply, plus proposed projects for Transmission Breaker Sustainment, Laverendrye Bank Addition and Laverendrye Capacitor Bank). Coordination of design drawings, station outages, and the various internal and external work crews within the yard, will be extremely complicated as a result.

Capital Budget Estimate

The annual and total net budget requirements are as follows (in thousands of dollars):

Fiscal Year	Proposed Budget
Prev. Actuals	\$ 171
2013/14	\$ 963
2014/15	\$ 5,516
2015/16	\$ 5,141
2016/17	\$ 19,773
2017/18	\$ 1,187
Total	\$ 32,752

Proposed Schedule

The key milestones for the major components are as follows:

Licensing		
Prepare and submit EIS	Sep 2012 – Dec 2013	
Environmental License Acquired	Mar 2014	
New 230kV Line & Terminations	New 230kV Line	230kV Line Terminations
Detailed Design	Sep 2014 – May 2016	Mar 2014 – Jul 2015
Material Procurement	Jul 2015 – May 2016	May 2014 – Aug 2015
Construction	Jul 2016 – Dec 2016	May 2015 – Aug 2016
Commissioning	Dec 2016 – Feb 2017	Aug 2016 – Feb 2017
Breaker Replacements	115kV Breakers	230kV Breakers
Detailed Design	Jun 2013 – Aug 2014	Mar 2014 – Mar 2015
Material Procurement	Jul 2013 – Sep 2014	May 2014 – May 2015
Construction	Nov 2014 – Jun 2017	Aug 2015 – Oct 2016
Commissioning	Feb 2015 – Jul 2017	Nov 2015 – Nov 2016

Capital Project Justification

Related Projects

- 1) Dorsey-Riel South Loop ROW Property Requirements (P-08497)
- 2) Bipole III Transmission Line & 2000MW Converters (1.5.2.1)
- 3) Riel 230/500kV Station (1.5.2.2.1.1)
- 4) Transmission Breaker Sustainment Capital Program (proposed, 1.1.2.3.57.1)

Reference Documents

- 1) SPD 2008/06, "Laverendrye - St. Vital New 230kV Line", K. Louie, April 28, 2008.
- 2) SPD 2008/20, "Laverendrye Station 230/115kV Circuit Breaker Replacement Requirements", M.R. Wonsiak, January 05, 2009.
- 3) SPD 2010/01, "Justification for the Advancement of the Laverendrye - St. Vital New 230 kV Line and the 230kV Breaker Replacement", B. Bagen, March 11, 2010.
- 4) TM 2012/09, "An Update on the Laverendrye Station 230/115kV Breaker Replacement Project (SPD 2008/20) Including the Voltage Source Converter (VSC) Based Bipole III Option", M. R. Wonsiak, December 27, 2012.
- 5) TAS 2013/02, "Capital Investment Planning for Transmission's Aging Infrastructure", B. Jorowski.

Capital Project Justification
Estimate Summary

Laverndrye - St. Vital 230kV Transmission & Breaker Replacements
(IM Node 1.1.2.3.48.1)

Internal Labour (Hours)	Project Total	2013/14
Apparatus Maintenance Div	5,194	-
Commissioning Dept	1,866	-
Communications Dept	1,550	-
Electrical Construction Dept	28,899	-
Engineering Contract Management Dept	-	-
Lic. & Env. Assessment Dept	659	550
Station Design Dept-Apparatus QC	1,167	551
Station Design Dept-Automation & Chris Eng.	14,344	3,050
Station Design Dept-Protection	1,318	706
Station Design Dept-Structures & Equip & Gmrdg	10,183	865
System Performance Dept	480	-
System Support Dept	2,406	-
Trans Line & Civil Constr Dept-construction	10,122	-
Trans Line & Civil Constr Dept-eng. survey serv.	1,120	-
Trans Line Mtce North & South Depts	-	-
Trans & Civil Design Dept-T/L Design	2,883	225
Trans & Civil Design Dept-Civil Design	3,352	150
Transmission Projects Dept	5,057	646
Subtotal - Transmission BU Resources	90,599	6,742
Corporate Relations BU	50	50
Distr Eng & Constr - Engineering Depts	-	-
Distr Eng & Constr - Construction Depts	1,040	-
Engineers-in-Training/Interns/Co-op Students	-	-
HR & Corporate Services BU - Haulage Services	48	-
HR & Corporate Services BU - Materials Mgmt	-	-
HR & Corporate Services BU - Property	-	-
Power Supply BU	714	-
Other (from all BUs)	198	9
Total Resource Requirements	92,649	6,801

Cost (Thousands of Dollars)	Project Total	2013/14
Property	\$ 186	\$ -
Internal Labour - Eng., Proj Mgmt & Admin	\$ 3,540	\$ 561
Internal Labour - Construction	\$ 4,024	\$ -
Consulting	\$ 225	\$ 159
Material	\$ 8,791	\$ 10
Contracted Construction Services	\$ 7,491	\$ -
Contingency	\$ 2,679	\$ -
Overhead (on labour & material)	\$ 796	\$ 140
General High Level / Other	\$ 2,102	\$ 58
Subtotal - Gross	\$ 29,834	\$ 929
Escalation & Interest	\$ 2,918	\$ 34
Total Net Cost	\$ 32,752	\$ 963

TRANSMISSION & DISTRIBUTION CAPITAL BUDGET RANKING TOOL

Matrix Scoring Sheet

See the CAPITAL BUDGET RANKING TOOL DOCUMENTATION for instructions and definitions.

Date Scored:
I.M. #
WBS # (if Domestic)

2013-04-16	NAME OF PROJECT:
1.1.2.3.48.1	La Verendrye - St. Vital New 230 kV Line and Breaker Replacements
Enter scores in grey cells = Weight X Probability points X Consequence points	
GOAL SCORES	COMMENTS / RATIONALE (Required) (do not split cells; press {Alt}{Enter} to start a new line / paragraph)
490	15 breakers exceed 95% of their Maximum Symmetrical Current Interrupting Rating, and are required to be replaced with additions of the new 230kV line as well as Riel Converter Station and Bipole III.
500	If the 230kV network in the Winnipeg area is out of service, the power system in Southern Manitoba will experience great operational difficulties and possibly even a blackout.
500	If the new line cannot be installed before Riel Sectionalization in 2014, the Dorsey-Forbes 500kV line prior outage transfer level would have to be reduced from 675MW to as low as 0MW. This will result in significant increase in Manitoba Hydro's share in the contingency reserve of the Midwest Contingency Reserve Sharing Group, and significant loss of export sales revenues.
50	The outage of the 230 kV network in the Winnipeg area seriously reduces the export capability of Manitoba Hydro power system.
Tier 1 ≥ 1,200; Tier 2 = 850-1,199; Tier 3 = 550-849; Tier 4 = 200-549 & Tier 5 < 200	
MATRIX SCORE:	1540 Tier 1

Weight	TRANSMISSION & DISTRIBUTION GOAL - Factor	Level 1 (=10 points)	Level 2 (=7 points)	Level 3 (=5 points)	Level 4 (=2 points)	Level 5 (=0 points)
10	SAFETY					
	Probability of risk to public or employee safety	HIGH	MEDIUM-HIGH	MEDIUM	LOW	does not apply
	Consequence of risk to public or employee safety	HIGH	MEDIUM-HIGH	MEDIUM	LOW	does not apply
10	SERVICE & RELIABILITY					
	Probability of:					
	- event affecting service to a customer OR	CERTAIN	HIGH	MEDIUM	LOW	does not apply
	- event affecting reliability of the transmission or distribution system	CERTAIN	HIGH	MEDIUM	LOW	does not apply
	Consequence of:					
	- event affecting service to a customer, OR	HIGH	MEDIUM-HIGH	MEDIUM	LOW	does not apply
	- event affecting reliability of the transmission or distribution system, OR	HIGH	MEDIUM-HIGH	MEDIUM	LOW	does not apply
	- event affecting reliability of the communications system	HIGH	MEDIUM-HIGH	MEDIUM	LOW	does not apply
5	FINANCIAL IMPACT					
	Probability of achieving financial impact	CERTAIN		LIKELY		does not apply
	Consequence:					
	- Net Present Value, OR	> \$1,000k	> \$100k and ≤ \$1,000k	> \$0 and ≤ \$100k		≤ \$0
	- Average avoided cost per year	> \$250k	> \$100k and ≤ \$250k	> \$30k and ≤ \$100k	> \$0 and ≤ \$30k	does not apply
5	TRANSFER CAPABILITY					
	Probability of impact to transfer capability			ALL PROJECTS		does not apply
	Consequence of increase to or prevent loss of transfer capability	> 50MW	>10MW and ≤ 50MW	> 0MW and ≤ 10MW	PREVENT LOSS	does not apply
5	ENVIRONMENT				2	
	Probability of negative or positive impact	HIGH		MEDIUM	LOW	does not apply
	Consequence of negative or positive impact	HIGH		MEDIUM	LOW	does not apply

CERN(1) Rev. 97 12

CAPITAL EXPENDITURE REVISION
(IN THOUSANDS OF DOLLARS)

Title Laverendrye Str 115KV Bkr Replacements	Coordinating Division Transmission Construction & Line Mice	Investment Management Node: 1.1.2.3.48.1 Project Number: P:15253
Owning Division Transmission Planning & Design		

DESCRIPTION:

Replacement at Laverendrye Station of ten 115KV breakers: the 115KV bus tie breaker, and the 115KV breakers of lines YM31 (to Morden), YT10 (to Treherne), YF11 (to Rosenfeld), YX47 and YX48 (to Ft. Garry-Mohanak & St James/Madison), YV5 (to St. Vital), YH33 (to Harrow), KY32 (from Kirkfield) and RY7 (from Rosser). Includes the installation of a hybrid SAS.

JUSTIFICATION:

System Planning's report SPD 2008/20 recommends replacement to address circuit breakers that are under-rated for the increase in available fault current that will occur upon completion of Bipole III and the Riel Converter Station. Fault current levels that exceed a circuit breaker's interrupt capability can result in catastrophic failure of the breaker, possibly causing serious injury to employees and/or the public.

CAPITAL INVESTMENT CATEGORIZATION:

Reliability: Import/Export-related - Capacity Enhancement - New Asset Addition (40%)
Reliability: Load-related - Capacity Enhancement - New Asset Addition (30%)
Reliability: Outage-related - Aging Infrastructure - Asset Improvement (30%)

REFERENCE:

1SPD 2008/20, "Laverendrye Station 230/115KV Circuit Breaker Replacement Requirements", M.R. Wonsiak, January 05, 2009.
2ITM 2010/01, "The Advancement of the Laverendrye- St. Vital 230KV Line's Effect on the Laverendrye Station 230/115 kV Breaker Replacement Project", M.R. Wonsiak, January 4, 2010.
3ITM 2012/09, "An update on the Laverendrye Station 230/115KV Breaker Replacement Project (SPD 2008/20) including the Voltage Source Converter (VSC) based Bipole III option", M.R. Wonsiak, December 27, 2012.

REVISION:

2013 05 25: New Item.

Contingency: \$595

REV. AMOUNTS:	IN SERVICE DATES				TOTAL NET COST		
	Actual cost to date: (Over)under expend:	GROSS	ESCALATION	INT. CAPITALIZED		SALVAGE	CONTRIBUTION
2015/02/28	47	627					Base estimate 2013/04/01 CLASS 2 Work start date 2011/07/01
2015/06/30	1	627	2016/03/31	627	2017/03/31	627	
2015/09/30		627	2016/06/30	627	2017/07/31	1324	
2015/12/31		627	2016/09/30	627			
Actual cost to date: (Over)under expend:	47		2016/12/31	627			
	-47			1			48
				-1			-48
V-HAP TOTAL							
REV. AMOUNTS:							
Actual cost to date (Over)under expend:	47			1			48
Auth 2013/14	533			13			546
Rep 2014/15	3679	74		157			3910
2015/16	530	16		189			735
2016/17	588	30		88			706
2017/18	943	73		8			1024
2018/19							
2019/20							
2020/21							
2021/22							
V-HLD TOTAL	6319	193		456			6968

Prepared by 2013/06/06	YY mm dd	Approved by <i>[Signature]</i> 2013/06/14	YY mm dd	Approved by <i>[Signature]</i> 2013/06/07	YY mm dd	Approved by VICE-PRESIDENT	YY mm dd
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CRN(1) Rev. 97 12

CAPITAL EXPENDITURE REVISION
(IN THOUSANDS OF DOLLARS)

Title St. Vital Strm Term 230kV Laverendrye T/L		Investment Management Node: 1.1.2.3.48.1
Owning Division Transmission Planning & Design	Coordinating Division Transmission Construction & Line Mice	Project Number: P:15257

DESCRIPTION:
Terminate the new 230kV T/L from Laverendrye to St. Vital at St. Vital Station including one 230kV breaker and its associated equipment in breaker position R11. Revise the protection system to accommodate the new line.

JUSTIFICATION:
System Planning's report SPD 2008/06 recommends installation of a new line between Laverendrye Station and St. Vital Station in order to upgrade the 230kV network in this area to a 230kV ring, which will improve the network's reliability as well as meet load growth in southern Manitoba.

CAPITAL INVESTMENT CATEGORIZATION:
Reliability: Import/Export-related - Capacity Enhancement - New Asset Addition (40%)
Reliability: Load-related - Capacity Enhancement - New Asset Addition (30%)
Reliability: Outage-related - Aging Infrastructure - Asset Improvement (30%)

REFERENCE:
1) SPD 2008/06, "Laverendrye - St. Vital New 230kV Line", K. Louie, April 28, 2008
2) SPD 2010/01, "Justification for the Advancement of the Laverendrye - St. Vital New 230kV Line and the 230kV Breaker Replacement", B. Bagan, March 11, 2010.

REVISION:
2013 05 25: New Item.
Contingency: \$244

2017/02/28	IN SERVICE DATES						Base estimate 2013/04/01 CLASS 2 Work start date 2011/04/01
	PREV AUTHORITY Actual cost to date: (Over)under expend:	GROSS	ESCALATION	INT. CAPITALIZED	SALVAGE	CONTRIBUTION	
		10		1			11
		-10		-1			-11
V-HAP TOTAL							
		10		1			11
		-1		-1			-1
		55	6	3			58
		424	27	11			441
		719	38	56			802
		685	3	86			789
		45					48
V-HLD TOTAL							
		1917	74	157			2148

Prepared by 2013/06/06	Yr mm dd	Approved by 08:35AM	Yr mm dd	Approved by 13/06/14	Yr mm dd	Approved by 13/06/07	Yr mm dd	Approved by VICE-PRESIDENT	Yr mm dd
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CERN1 Rev. 97 12

CAPITAL EXPENDITURE REVISION
(IN THOUSANDS OF DOLLARS)

Title Laverendrye - St. Vital New 230KV T/L	Investment Management Node: 1.1.2.3.48.1
Owning Division Transmission Planning & Design	Project Number: P:15260
Coordinating Division Transmission Construction & Line Mice	

DESCRIPTION:

Environmental licensing, and design and installation of 37 km of 230KV overhead transmission line from Laverendrye to St. Vital Stations.

JUSTIFICATION:

System Planning's report SPD 2008/06 recommends installation of a new line between Laverendrye Station and St. Vital Station in order to upgrade the 230KV network in this area to a 230KV ring, which will improve the network's reliability as well as meet load growth in southern Manitoba.

CAPITAL INVESTMENT CATEGORIZATION:

- Reliability: Import/Export-related - Capacity Enhancement - New Asset Addition (40%)
- Reliability: Load-related - Capacity Enhancement - New Asset Addition (30%)
- Reliability: Outage-related - Aging Infrastructure - Asset Improvement (30%)

REFERENCE:

- 1) SPD 2008/06, "Laverendrye - St. Vital New 230KV Line", K. Louie, April 28, 2008.
- 2) SPD 2010/01, "Justification for the Advancement of the Laverendrye - St. Vital New 230KV Line and the 230KV Breaker Replacement", B. Bagen, March 11, 2010.

REVISION:

- 2013 05 25: New Item.
- Contingency: \$1241

2017/02/28	IN SERVICE DATES					Base estimate 2013/04/01 CLASS 2 Work start date 2010/07/01	
	PREV AUTHORITY Actual cost to date: (Over)under expend:	GROSS	ESCALATION	INT. CAPITALIZED	SALVAGE		CONTRIBUTION
	85			10			95
	-85			-10			-95
V-HAP TOTAL							
REV. AMOUNTS:							
Actual cost to date:	85			10			95
(Over)under expend:							
Auth 2013/14	322	1		16			339
Rec 2014/15	361	6		36			403
2015/16	319	10		56			385
2016/17	15127	965		485			16567
2017/18	43	3					46
V-HLD TOTAL	16258	975		603			17836
Prepared by YV mm dd	Approved by YV mm dd	Approved by YV mm dd	Approved by YV mm dd	Approved by YV mm dd	Approved by YV mm dd	Approved by YV mm dd	Approved by YV mm dd

2013/06/06

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YV mm dd
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VICE-PRESIDENT

**CAPITAL INVESTMENT JUSTIFICATION ADDENDUM
FOR**

Laverendrye - St. Vital 230kV Line & Breaker Replacement
Investment Type (Project)
Addendum Number 1

	<u>PREVIOUSLY APPROVED</u>	<u>REVISED</u>	<u>INCREASE/ (DECREASE)</u>
BUDGET:	\$32,752	\$58,725	\$25,974
CONTRIBUTIONS:	\$0	\$0	\$0
NET BUDGET:	\$32,752	\$58,725	\$25,974
(values listed above are in thousands of dollars)			
CORPORATE VALUE	Value:	Value: 24,824	
FRAMEWORK SCORE:	Value/\$K:	Value/\$K: 0.63	

DATE PREPARED: 2022-05-10

**EC/MHEB APPROVAL MINUTE &
DATE:**

AFC approval 6/24/2022
minute 102.7

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
Turner, Hal	VP ASSET PLANNING & DELIVERY		VP Asset Planning & Delivery	2022-06-06
Pawluk, James	DIRECTOR ASSET MANAGEMENT		Director - Asset Management	2022-06-03
Bowen, Dave	DIRECTOR PROJECT MANAGEMENT		Director Project Management	2022-06-03
Halayko, Krista	ASSET MGMT STRATEGY & PLANNING DEPT MGR		Asset Management Strategy & Planning	2022-06-02
Wowryk, Nicole	TRANS & DIST PROJECTS DEPT MANAGER		Transmission & Distribution Projects	2022-06-01
Braid, Kristin	GRID INFRASTRUCTURE PLANNING DEPT MGR		Grid Infrastructure Planning	2022-05-31
Ewanchuk, Calvin	PROFESSIONAL ENGINEER		Grid Infrastructure Planning	2022-05-31
Long, Krista	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2022-05-31
Collet, Luc	PROJECT OFFICER		Transmission & Distribution Projects	2022-05-31
Bell, Christine	PORTFOLIO ACCOUNTANT		Asset Management Strategy & Planning	2022-05-10

ADDENDUM NUMBER	DATE	REVISION (Summary of change)
Original CPJ	2013/06/19	New item

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Asset Planning & Delivery	REQUESTING OPERATING/CORPORATE GROUP:	Asset Planning & Delivery
RESPONSIBLE DIVISION:	Project Management	REQUESTING DIVISION:	Transmission Planning & Design
RESPONSIBLE DEPARTMENT:	Transmission & Distribution Projects	ISD: (YYYY/MM/DD)	2024/03/31
I.M. NODE NUMBER:	2.1.30.15.02.34	W.B.S. NUMBERS:	P:15253, P:15257, P:15258, P:15260, P:17331, P:30457
C55 INVESTMENT CODE:	13709		
SAP PROJECT TYPE:	22 - BOC-Executive Committee	C55 INVESTMENT SUB-CATEGORY:	Shell
CORPORATE INVESTMENT CATEGORIZATION:	(Level 1) C1 / Capacity & Growth (Level 2) CF / System Load Capacity		

CONTACTS			
PREPARED BY:	Ewanchuk, Calvin PROFESSIONAL ENGINEER 52080	REQUESTOR:	Calvin Ewanchuk, System Planning Dept
PROJECT MANAGER:	Collet, Luc PROJECT OFFICER 52710		

MANITOBA HYDRO
CAPITAL INVESTMENT JUSTIFICATION ADDENDUM
Laverendrye - St. Vital 230kV Line & Breaker Replacement

RECOMMENDATION

Approve an increase of \$25.9 million to \$58.7 million from last approved CIJ amount of \$32.8 million due primarily to dated estimates that were recently refreshed and reflect higher transmission line construction costs, supply chain issues resulting from the pandemic and refined estimates for the station terminations.

SCOPE

No change in scope.

BACKGROUND

The reliability of the 230kV network in Winnipeg area has a significant impact on the successful operation of the Manitoba Hydro power system. Given that the 230kV network almost completely encircles the City of Winnipeg except for the region between Laverendrye and St. Vital stations, under certain severe outages the network would be broken into segments with some stations becoming isolated, resulting in difficulties operating the system and possible blackouts. Neither Dorsey nor Riel Converter Stations directly supply customer load. Instead, Dorsey and Riel supply power at the 230kV level to stations in the Winnipeg area such as Laverendrye, Rosser and St. Vital which are designed to step-down voltages and send power to the various sub-stations that directly supply customers.

Laverendrye Station is fed by three 230kV lines from Dorsey station with all three lines sharing a common right-of-way (ROW). The 230kV network in south-central Manitoba and the 115kV and 66kV systems in the south-west corner of the City of Winnipeg depend heavily on Laverendrye Station for their supply. Supply to St. Vital Station is via two 230kV lines from Riel Station and a 230kV line from Dorsey with all 3 lines on the same ROW east of the station. The electricity needs directly south of Winnipeg and of the 115kV, 66kV and 24kV systems in the south-east corner of the city have a strong reliance on St. Vital Station for their supply. Extreme events could limit the ability of Dorsey and/or Riel Stations to feed power into either the Laverendrye or St. Vital Stations. To improve resilience and ensure reliability of the power system in case of extreme events, System Planning's report SPD 2008/06[1] recommends installation of a new 230kV line between Laverendrye Station and St. Vital Station in order to effectively "close the loop" of the 230kV network around the city of Winnipeg. This new 230kV line (Y36V) would allow large quantities of power to flow from Laverendrye to St. Vital, or vice versa, as required, ensuring continuity of supply to the 115kV, 66kV and 24kV systems across southern Winnipeg as well as the 230kV network south of the city. Work completed to date includes the replacement of ten 115kV breakers and five 230kV breakers at the Laverendrye Station.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

JUSTIFICATION

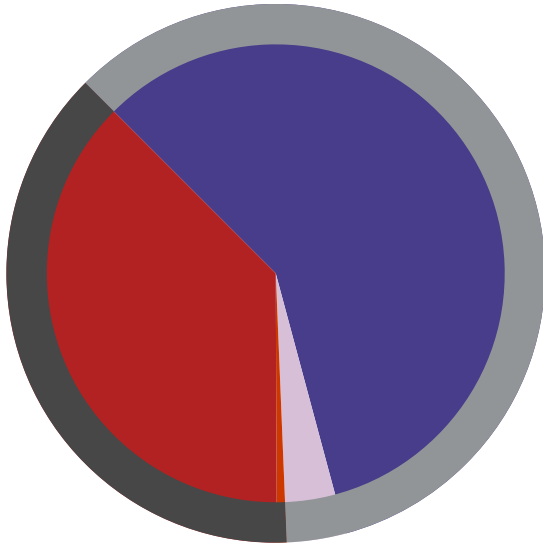
The justification for this complex has evolved to address mainly the issue of reliability within the southern 230kV system. The new transmission line that will connect the Laverendrye and St. Vital stations ensures the ability to

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

continue to meet existing load in the event that either station can not be fed via their connection to the HVDC system. The value shown in the addendum includes only the Transmission Line and Terminations and does not include the value for any work completed to date. The costs reflected in this addendum capture all of the work including the work already completed. The quantified value associated with the remaining work (completion of the Transmission Line) is significantly positive, nearly double the cost of the Line itself. Not completing the line would result in stranded transmission assets that would likely need to be salvaged.

The project's original ISD has been deferred because of design changes and resources diverted to major capital projects. The increase in costs is due primarily to dated estimates from 2013 (original CPJ) that were recently re-estimated and are based on a better understanding of the work to be performed. These higher transmission line construction costs are mostly driven by higher contract costs but are also influenced by additional internal efforts required to complete the project.

CORPORATE VALUE FRAMEWORK (REVISED)



Value Measure	Value Points	% of Value
Transmission Reliability Risk	61,066	58.32%
Stakeholder Perception Risk	3,702	3.54%
O&M Costs	-607	0.58%
Total Cost	-39,337	37.57%
Total Value	24,824	
Value/\$K	0.63	

ANALYSIS OF ALTERNATIVES:

ECONOMIC ANALYSIS	
Discount Rate	For current corporate rates see P911 6%

Active Option	NPV Benefits/(Costs)	CVF Score	Value/\$K
Preferred		24,824	0.63

INVESTMENT RISK ANALYSIS
<p>Contingency of \$8.1M has been included to cover scope, schedule and budget following a risk review and contingency analysis. The contingency consists of \$4.0M of systemic risks and \$4.1M of project specific risks which is further broken down into the following:</p> <p>Systemic Risks:</p> <ul style="list-style-type: none"> • Systemic risks are those not unique to a particular project’s scope, attributes, or delivery strategy. They are risk all projects face as a result of uncertainties within an industry, company, culture, technology or similar over-arching characteristics. <p>Project Specific Risks:</p> <p>Schedule:</p> <ul style="list-style-type: none"> • Resources - Due to supply chain issues, the material could be delayed significantly which would negatively impact the project schedule as the steel structures are currently on the critical path. This could result in additional contract claims if the materials are not received when planned for. • Property acquisition delays resulting from the property acquisition issues with the City of Winnipeg tree nursery and Brady Landfill. <p>Budget:</p> <ul style="list-style-type: none"> • Foundation installation difficulties with the specialty floodway structures because these foundations will be extremely large (requested by Manitoba Infrastructure). • Contractor claims due to unfavorable weather and material delivery delays. • Contingency in the amount of \$4.1M has been included to address budget risks.

MANITOBA HYDRO
CAPITAL INVESTMENT JUSTIFICATION ADDENDUM
Laverendrye - St. Vital 230kV Line & Breaker Replacement

ESTIMATED COST FLOW

The annual projected cost flows are as follows (in thousands of dollars):

	PREVIOUSLY APPROVED			PROPOSED			INCREASE / (DECREASE)		
Fiscal Year	Budget	Contributions	Net Budget	Budget	Contributions	Net Budget	Budget	Contributions	Net Budget
Prev. Actuals	\$32,752	\$0	\$32,752	\$16,686	\$0	\$16,686	(\$16,066)	\$0	(\$16,066)
2022/2023	\$0	\$0	\$0	\$20,126	\$0	\$20,126	\$20,126	\$0	\$20,126
2023/2024	\$0	\$0	\$0	\$21,885	\$0	\$21,885	\$21,885	\$0	\$21,885
2024/2025	\$0	\$0	\$0	\$28	\$0	\$28	\$28	\$0	\$28
2025/2026	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2026/2027	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2027/2028+	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Total	\$32,752	\$0	\$32,752	\$58,725	\$0	\$58,725	\$25,974	\$0	\$25,974

IMPACT ON O&A COSTS

There will be additional maintenance costs associated with the new Laverendrye to St. Vital transmission line. The impact is expected to be minimal.

MANITOBA HYDRO
CAPITAL INVESTMENT JUSTIFICATION ADDENDUM
Laverendrye - St. Vital 230kV Line & Breaker Replacement

PROPOSED SCHEDULE

- 115kV Breaker Replacements: completed October 2017
- 230kV Breaker Replacements: completed December 2017
- New Y36V transmission line: Proposed construction start is September 2022 with a ISD March 2024
- St. Vital termination: March 2024
- Laverendrye Termination: March 2024
- Telecommunication additions at St. Vital and Laverendrye stations: March 2024

RELATED INVESTMENTS

- Bipole III Transmission Line & 2000MW Converters (2.5.2)
- Riel 230/500kV Station (2.5.11.1.01.1)
- Transmission Breaker Sustainment Capital Program (2.1.30.15.02.42)
- Laverendrye - St. Vital 230kV Transmission Line (TBD)

OTHER ALTERNATIVES CONSIDERED

No other alternatives considered.

REFERENCE DOCUMENTS

[Approved CPJ](#)

C55-CIC

**CAPITAL INVESTMENT CONCEPT
FOR**

Southwest Winnipeg 115kV Transmission Improvement-Phase 2

Investment Type (Project)

SCOPE DEVELOPMENT FUNDS: (Net of Contributions)	\$(695)
CONCEPT ESTIMATE (incl. Scope Development):	\$47,083
CONTRIBUTIONS:	(\$1,591)
NET CONCEPT ESTIMATE (incl. Scope Development):	\$45,492
(values listed above are in thousands of dollars)	
CORPORATE VALUE	Value: 12,094
FRAMEWORK SCORE :	Value/\$K: 0.32

DATE PREPARED: 2018/12/12

**EC/MHEB APPROVAL MINUTE &
DATE:**

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
MAILEY, SHANE	VP TRANSMISSION		VP Transmission	2019/01/03
PENNER, GLENN	DIRECTOR TRANSMISSION CONST & LINE MTCE		Director - Trans Const & Line Mtc	2019/01/03
NEUFELD, GERALD	DIRECTOR TRANSMISSION PLANNING & DESIGN		Director - Trans Planning & Design	2019/01/03
ADAMKOWICZ, MARK	TRANSMISSION PROJECTS DEPARTMENT MGR		Transmission Project Management	2018/12/21
JACOBSON, DAVID	INTERCONNECTION PLANNING SECTION HEAD	On behalf Of SWATEK, DAVID (drswatek).	System Planning	2018/12/21
TOEWS, KURTIS	PROFESSIONAL ENGINEER		System Planning	2018/12/21
LONG, KRISTA	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2018/12/20
ALMEIDA, ANDREA	PROJECT ENGINEER		Transmission Project Management	2018/12/20
BELL, CHRISTINE	TRANS CAPITAL PORTFOLIO ACCOUNTANT		Transmission Project Management	2018/12/12

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Transmission	REQUESTING OPERATING/CORPORATE GROUP:	Transmission
RESPONSIBLE DIVISION:	Transmission Construction & Line Mtce	REQUESTING DIVISION:	Transmission Planning & Design
RESPONSIBLE DEPARTMENT:	Transmission Projects Department	ISD: (YYYY/MM/DD)	2019/06/30
I.M. NODE NUMBER:	2.1.30.15.02.92	W.B.S. NUMBERS:	P:17621, P:17624, P:17626, P:17628,
C55 INVESTMENT CODE:	20555		
SAP PROJECT TYPE:	23 - BOC-Corporate Asset Mgmt Exec Committee	C55 INVESTMENT SUB-CATEGORY:	Shell
CORPORATE INVESTMENT CATEGORIES:	(Level 1) C1 / Capacity & Growth (Level 2) CF / System Load Capacity		

CONTACTS

PREPARED BY:	TOEWS, KURTIS PROFESSIONAL ENGINEER 52080	REQUESTOR:	Kurtis Toews, System Planning Department
PROJECT MANAGER:	ALMEIDA, ANDREA PROJECT ENGINEER 52710		

MANITOBA HYDRO CAPITAL INVESTMENT CONCEPT

Southwest Winnipeg 115kV Transmission Improvement-Phase 2

RECOMMENDATION

Approve scope development to review the detailed design and construction estimate for improving the reliability of the Southwest Winnipeg 115kV transmission area. Reliability will be improved by increasing the capacity of lines VS27, YS33, VH1 by constructing new double circuit tubular towers in the same alignment as the existing double circuit lattice towers with a lower weight conductor and terminating the YV5 line leading into the Mohawk station.

This scope CIC is a credit of \$695K which is composed of:

- A customer contribution paid by Shindico of \$1,200K
- Accumulated interest of \$391K on the contribution
- Scope development costs of \$896K.

SCOPE

CIC Scope Development

- Finalize Induction Study
- The Geotechnical investigation was completed November 2018. The lab testing will be completed by February 2019.
- Schedule

The majority of the scope development was completed by June 2018.

Construction Scope

Rebuild line YS33 from Laverendrye station to the Bus Rapid Transit corridor and from Stafford station to the Bus Rapid Transit corridor. The remainder of line YS33 has already been rebuilt under a separate project and is therefore outside the scope of this project. Upgrade risers at Harrow station on line VH1 and XH46. Upgrade line YS33 risers at Laverendrye station. Open line YV5 at Mohawk station and create a new St Vital to Mohawk line by terminating one end of it on the Mohawk 115 kV ring bus.

Rebuild line VS27 from St. Vital station to the Bus Rapid Transit corridor and from Stafford station to the Bus Rapid Transit corridor with a conductor that has a minimum summer rating of 1081 A. The remainder of line VS27 has already been rebuilt under a separate project and is therefore outside the scope of this project. Upgrade line VS27 risers at St Vital station. Rebuild a portion of line VH1 from St Vital to Harrow station with a conductor that has a minimum summer rating of 1081 A.

BACKGROUND

The scope of this work was originally approved in 2013 under the Southwest Winnipeg 115kV Transmission Improvements project (2.1.30.15.02.39). In 2015, the City of Winnipeg began design of the Bus Rapid Transit project. Their project required relocation of a portion of the YS33 and VS27 lines and the modification of an additional line. The BRT project also required the work to be completed ahead of the original approved schedule for the original project. This work was completed in 2016. It was decided to close the BRT portion of the project and move forward with the remaining work as a new project as the scope of the two projects were now vastly different.

BACKGROUND

The project is broken into two stages to manage outages. The first stage includes the rebuilding of YS33 and terminating line YV5 in Mohawk Station. The second stage includes rebuilding VS27 and VH1.

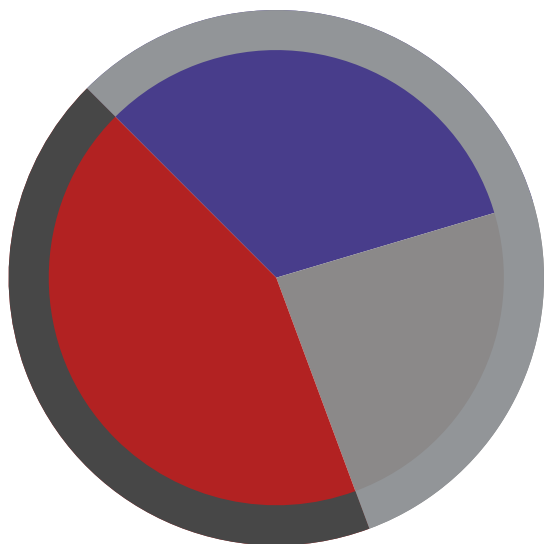
Prior to the approval of the original project, a non-refundable contribution in aid of construction in the amount of \$1 200,000 was received from Shindico Realty Inc. in consideration of work to be undertaken by Manitoba Hydro on the Taylor Avenue easement to ensure the future transmission line connecting into Harrow Station will be completed without widening the easement corridor.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

JUSTIFICATION

The project will improve the reliability of the transmission supply to customers in south and central Winnipeg by reducing the risk of line overloads during periods of summer peak loading. The project will also eliminate violations of NERC planning criteria by eliminating line overloads. Terminating line YV5 into Mohawk station will eliminate overloads on 115 kV line XV39 which are expected to begin in the summer of 2019. The transmission line changes in Stages 1 and 2 will eliminate overloads on 115 kV lines VS27, YS33, and VH1 which are expected to begin in the summer of 2020

CORPORATE VALUE FRAMEWORK



Value Measure	Value Points	% of Value
Transmission Reliability Risk	29,020	32.9%
Compliance Risk	21,132	23.96%
Total Cost	-38,059	43.15%
Total Value	12,094	
Value/ŞK	0.32	

OTHER ALTERNATIVES CONSIDERED

Two other construction options were considered for increasing the capacity of the transmission lines.

1. Salvage the existing steel lattice structures and rebuild the line with new tubular structures. Install 954 kcmil ACSR conductor on the new structures. This would require larger structures increasing the project budget. These options would allow for an increased capacity of the lines in the future however additional station work would also be required. This option was not selected due to the additional cost and unknown need for an increase of capacity of these lines in the future.

2. Enhance the existing steel lattice structures and re-conductor the line using 636 kcmil ACSS conductor. The documentation on the towers and foundations are limited as many towers are as old 85 years. This option was not selected due to the risks associated with design and construction of this option was reflected in a higher budget estimate than the chosen option.

INVESTMENT RISK ANALYSIS

The existing scope assumes the outages will be given on YS33/XH46/YV5 and VS27/VH1 independently. Prolonged delay of this project could alter allowed outages requiring further scope development.

ESTIMATED COST FLOW

The annual projected cost flows are as follows (in thousands of dollars):

Fiscal Year	Scope Development Funds	Concept Estimate	Total Estimated Investment (Net of Contrib.)
Prev. Actuals	\$(1,218)	0	(\$1,218)
2018/2019	\$420	\$0	\$420
2019/2020	\$102	\$0	\$102
2020/2021	\$0	\$713	\$713
2021/2022	\$0	\$35,585	\$35,585
2022/2023	\$0	\$9,889	\$9,889
2023/2024+	\$0	\$0	\$0
Total	(\$695)	\$46,187	\$45,492

IMPACT ON O&A COSTS

No significant impact on O&A costs.

RELATED INVESTMENTS

2.1.30.15.02.39 Southwest Winnipeg 115kV Transmission Improvements

REFERENCE DOCUMENTS

[System Planning Single Line Diagram – Stage 1 Transmission Line](#)

[System Planning Single Line Diagram – Stage 1 Mohawk Station](#)

[System Planning Single Line Diagram – Stage 2 Transmission Line](#)

C55-CIJ-PROJ

**CAPITAL INVESTMENT JUSTIFICATION
FOR**

Southwest Winnipeg 115kV Transmission Improvements-Phase 2

Investment Type (Project)

BUDGET:	\$45,232
CONTRIBUTIONS:	(\$1,200)
NET BUDGET:	\$44,032
(values listed above are in thousands of dollars)	
CORPORATE VALUE	Value: 11,814
FRAMEWORK SCORE:	Value/\$K: 0.32

DATE PREPARED: 2019/12/09

**EC/MHEB APPROVAL MINUTE &
DATE:** Approved by Jay Grewal
December 18, 2019

APPROVER	APPROVER TITLE	COMMENT	ORGANIZATIONAL UNIT	APPROVAL DATE
Mailey, Shane	VP TRANSMISSION		VP Transmission	2019/12/12
Penner, Glenn	DIRECTOR TRANSMISSION CONST & LINE MTCE		Director - Trans Const & Line Mtc	2019/12/11
Neufeld, Gerald	DIRECTOR TRANSMISSION PLANNING & DESIGN		Director - Trans Planning & Design	2019/12/11
Neufeld, Maria	TRANSMISSION ASSET MANAGEMENT DEPT MGR		Transmission Asset Management	2019/12/11
Adamkowicz, Mark	TRANSMISSION PROJECTS DEPARTMENT MGR		Transmission Project Management	2019/12/11
Swatek, David	SYSTEM PLANNING DEPARTMENT MANAGER		System Planning	2019/12/11
Toews, Kurtis	SENIOR PLANNING ENGINEER		System Planning	2019/12/10
Long, Krista	CHARTERED PROFESSIONAL ACCOUNTANT		Financial Advisory Services	2019/12/10
Almeida, Andrea	PROJECT ENGINEER		Transmission Project Management	2019/12/09
Bell, Christine	PORTFOLIO ACCOUNTANT		Transmission Asset Management	2019/12/09

CAPITAL INVESTMENT MASTER DATA			
RESPONSIBLE OPERATING/CORPORATE GROUP:	Transmission	REQUESTING OPERATING/CORPORATE GROUP:	Transmission
RESPONSIBLE DIVISION:	Transmission Construction & Line Mtce	REQUESTING DIVISION:	Transmission Planning & Design
RESPONSIBLE DEPARTMENT:	Transmission Projects Department	ISD: (YYYY/MM/DD)	2022/11/30
I.M. NODE NUMBER:	2.1.30.15.02.92	W.B.S. NUMBERs:	P:17621, P:17624, P:17626, P:17628,
C55 INVESTMENT CODE:	20555		
SAP PROJECT TYPE:	22 - BOC-Executive Committee	C55 INVESTMENT SUB-CATEGORY:	Shell
CORPORATE INVESTMENT CATEGORIES:	(Level 1) C1 / Capacity & Growth (Level 2) CF / System Load Capacity		

CONTACTS			
PREPARED BY:	Toews, Kurtis SENIOR PLANNING ENGINEER 52080	REQUESTOR:	Kurtis Toews, System Planning Dept.
PROJECT MANAGER:	Almeida, Andrea PROJECT ENGINEER 52710		

MANITOBA HYDRO
CAPITAL INVESTMENT JUSTIFICATION
Southwest Winnipeg 115kV Transmission Improvements-Phase 2

RECOMMENDATION

Approve a budget of \$44.0 million for the detailed design and rebuild of two double circuit transmission tower lines to increase capacity which will improve the reliability of the Southwest Winnipeg 115kV transmission area.

SCOPE

Terminating line YV5, that currently runs from St.Vital station to Wilkes Station, into Mohawk 115kV ring bus.

Rebuild:

- Line YS33 from Laverendrye station to the Bus Rapid Transit corridor and from Stafford station to the Bus Rapid Transit corridor, 18km total.
- Line VS27 from St. Vital station to the Bus Rapid Transit corridor and from Stafford station to the Bus Rapid Transit corridor, 9km total.
- A 5km portion of line VH1 from St Vital to Harrow station with a conductor that has a minimum summer rating of 1081 A.

Upgrade risers at:

- Harrow station on line VH1 and XH46
- Laverendrye station on line YS33
- St Vital station on line VS27 and VH1

The remainders of lines YS33 and VS27, 4.4km each, have already been rebuilt under a separate project and are therefore outside of the scope of this project.

BACKGROUND

The scope of this work was originally approved in 2013 under the Southwest Winnipeg 115kV Improvements project. In 2015, the City of Winnipeg began design of the Bus Rapid Transit (BRT) project. The BRT project required relocation of a portion of the YS33 and VS27 transmission lines and the modification of an additional line. This BRT work was completed in 2016, with the remaining work raised as this new project.

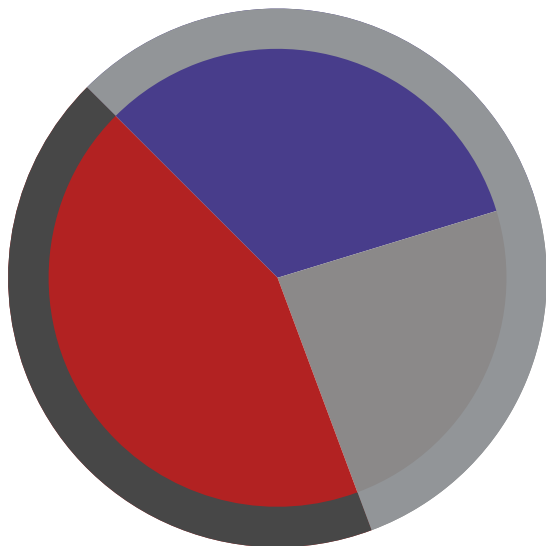
A non-refundable contribution in aid of construction in the amount of \$1.2 million has been received from Shindico Realty Inc. to ensure the future transmission line connecting into Harrow Station will be completed without widening the easement corridor.

JUSTIFICATION – BUSINESS CASE ANALYSIS (SUMMARY):

JUSTIFICATION

The project will improve the reliability of the transmission supply to customers in south and central Winnipeg by reducing the risk of line overloads during periods of summer peak loading. The project will also eliminate violations of NERC planning criteria by eliminating line overloads. Terminating line YV5 into Mohawk station will eliminate post-contingency overloads on 115 kV line XV39 which are expected to begin in the summer of 2020. Increasing capacity of the transmission lines will eliminate post-contingency overloads on 115 kV lines VS27, YS33, and VH1 which are expected to begin in the summer of 2020.

CORPORATE VALUE FRAMEWORK



Value Measure	Value Points	% of Value
Transmission Reliability Risk	28,393	32.78%
Compliance Risk	20,827	24.04%
Total Cost	-37,405	43.18%
Total Value	11,814	
Value/\$K	0.32	

ANALYSIS OF ALTERNATIVES:

ECONOMIC ANALYSIS		
Discount Rate	For current corporate rates see P911 6%	

Active Option	NPV Benefits/(Costs)	CVF Score	Value/\$K
Preferred Option (after interest and escalation)		11,814	0.32

Other Alternatives	NPV Benefits/(Costs)	CVF Score	Value/\$K
Preferred Option (before interest and escalation)		18,442	0.60
Modify Structures & Reconductor Using 636		17,419	0.57
Rebuild with 954 conductor		15,593	0.46

INVESTMENT RISK ANALYSIS
The existing scope assumes the outages will be given on YS33/XH46/YV5 and VS27/VH1 independently. Prolonged delay of this project could alter allowed outages requiring an increase to the scope and budget for additional design and construction, delaying the in-service dates.

ESTIMATED COST FLOW			
The annual projected cost flows are as follows (in thousands of dollars):			
Fiscal Year	Budget	Contributions	Net Budget
Prev. Actuals	\$294	(\$1,200)	(\$906)
2019/2020	\$536	\$0	\$536
2020/2021	\$1,696	\$0	\$1,696
2021/2022	\$17,238	\$0	\$17,238
2022/2023	\$25,459	\$0	\$25,459
2023/2024	\$8	\$0	\$8
2024/2025+	\$0	\$0	\$0
Total	\$45,232	(\$1,200)	\$44,032

IMPACT ON O&A COSTS
No significant impact on O&A costs.

PROPOSED SCHEDULE

Begin construction – February 2021
YV5 Termination into Mohawk Station in-service date May 2021
Rebuild of YS33 - in-service date May 2022
Rebuild of VS27 - in-service date November 2022

RELATED INVESTMENTS

2.1.30.15.02.39 Southwest Winnipeg 115kV Transmission Improvements

OTHER ALTERNATIVES CONSIDERED

Two other construction options were considered for increasing the capacity of the transmission lines.

1. Salvage the existing steel lattice structures and rebuild the line with new tubular structures. Install 954 kcmil ACSR conductor on the new structures. This would require larger structures increasing the project budget. These options would allow for an increased capacity of the lines in the future however additional station work would also be required. This option was not selected due to the additional cost and unknown need for an increase of capacity of these lines in the future.
2. Enhance the existing steel lattice structures and re-conductor the line using 636 kcmil ACSS conductor. The documentation on the towers and foundations are limited as many towers are as old 85 years. This option was not selected due to the risks associated with design and construction of this option which reflected in a higher budget estimate than the chosen option.

REFERENCE DOCUMENTS

[20555_CIC_Southwest Wpg 115kV Trans Impr.docx](#)
[CVF Summary Report 20555 CIJ.pdf](#)