ONTARIO POWER GENERATION

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Business Case Summary

Project #	13-83072	**Controlled Doc #**	P-BCS-36110-0709109 Rev 001
Project Title	Pickering Buried Boiler Blowdown Pipe Replacement		
Facility	Pickering	**Investment Classification**	Sustaining
Project Level (Scalability)	C	**Financial Classification**	☐ OM&A ☒ Capital ☐ Capital Spare ☐ MFA ☐ CMFA ☐ Provision ☐ Others: [if applicable]
Release: Gate and Project Phase	☐ Choose an item. G0☐: Initiation ☐ Choose an item. G1☐: Choose an item.		☐ Choose an item. G2☐: ☒ Full G3B: Execution
Estimate Class (overall project)	Class 3	**Target Project Completion Date**	NOV-2020

Recommendation

We recommend a release of $7,728K, including [redacted] f contingency. Specific contingency has been allocated to address further discovery issues and repair strategies for the thrust block and existing piping condition.

The estimated total project cost is $20,948 K, including total project contingency of [redacted]. The overall estimate has not increased since the previous release.

This project will replace Buried Boiler Blowdown piping in Units 1,4,5,6 (Engineer, Procure, and Construct (EPC)). The project will also issue Temporary Modification (TMOD) Packages for Units 7, 8 (Engineering (E) Only).

Investment Cash Flows

$K	LTD	2019	2020	2021	2022	2023	2024	Future	Total
Previous releases	4,941	8,279							13,220
Current request	-	6,202	1,366	160					7,728
Total released to date	**4,941**	**14,481**	**1,366**	**160**	**-**	**-**	**-**	**-**	**20,948**
Future required	-	-							-
Total Project Cost	**4,941**	**14,481**	**1,366**	**160**	**-**	**-**	**-**	**-**	**20,948**
Ongoing Costs	-								
					Gate:	**G3**	**OAR Approval:**		$20,948 K

Approvals	Signatures	Date
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Project Sponsor Jey Alalasuntharam Manager, Components & Equipment		July 18, 2019
I concur with the business decision as documented in this BCS.		
Finance Approval: Louisa Kwan Director, Controllership (acting)		July 23, 2019
I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		
Line Approval per OAR 1.1: Randy Lockwood SVP, Pickering	for RBL	July 26, 19

EXECUTIVE SUMMARY – Project Overview

The Buried Boiler Blowdown (BBD) carbon steel piping at Pickering Nuclear Generating Station (PNGS) will require replacement due to known degradation detected during recent inspections. The desired outcome is to maintain unit operation and address potential steam safety hazards. The benefit in replacing buried Boiler Blowdown piping is to reduce the risk of blowdown failures that can take the Units out of service for approximately 40 days for repairs, resulting in a generation loss of $20 M per system failure. If buried Boiler Blowdown piping line failure occurs in multiple units, this could result in approximately >$50M loss of generation revenue.

*Associated with OPG-STD-0076, Developing And Documenting Business Cases

Project #: 13-83072
Project Title: Pickering Buried Boiler Blowdown Pipe Replacement
Document #: P-BCS-36110-0709109 Rev 001

EXECUTIVE SUMMARY – Project Overview

The preferred alternative is to replace one of the two, 6 inch carbon steel buried Boiler Blowdown pipes in U1, U4, U5 and U6 between north and south pit along with concrete transite pipe at excavation location. The tie-in to merge 2 pipes into one will be completed up stream of north pit and splitting of pipe will be completed in south pit or down stream. Removal and replacement of the 6 inch piping will be carried out by having two open pits at the 45 degree pipe anchor, near the middle of the 260 feet pipe run, between the two open manholes at the reactor buildings and the screenhouses.

This release is to fund the following scope of work:

- Complete Construction of the final two units
- Complete the tie ins and AFS for all units

The following risks are currently known with an allocated cost to address them (with technical assumptions) of $1,863K which has been accounted in total release above.

1) Repairs to U5/U6 damaged Thrust Block ($1,346K).
2) Installation of U1 vent line to address possible water hammer issues post commissioning of newly installed pipe ($346K).
3) U4 has a sink hole downstream of the south pit and there is a potential that more sink holes can develop ($171K).

If the mitigation actions for these known issues are outside of the assumed technical boundaries further funding will be required.

History of scope and schedule changes:

The scope of the project has not changed between this release and the partial execution release from P-BCS-36110-0709109.

The current target in service date is NOV-2020 which has the final tie in must be performed during P2041. If there is opportunity to advance this date, the project will look to perform tie ins during unplanned outages.

Project is on schedule and is on budget:

Unit 1 excavation and pit to pit piping is complete as per schedule.

Unit 5/6 excavation started as per schedule and pit to pit piping installation is on track to be completed in 2019.

Unit 4 excavation and piping installation is on plan to be completed in 2019

Preferred Alternative: **Push/Pull Pit-to-pit Pipe Replacement** For Project Level A, B or C

Description of Preferred Alternative

The preferred alternative is to replace one of the two, 6 inch carbon steel buried Boiler Blowdown pipes on units 1 and 4 and replace one of the two lines on units 5 and 6 reusing most of the existing transite pipe which is the outer concrete pipe. Removal and replacement of the 6 inch piping will be carried out by having two open pits at the 45 degree pipe anchor, near the middle of the 260 feet pipe run, between the two open manholes at the reactor buildings and the screenhouses.

The open pits will allow access to pull and cut out sections of the 6 inch pipe in 10-20 feet increments and install the new pipe by pushing and welding the pipe back into the existing transite pipe, without the need to excavate the total pipe run. A transite pipe repair contingency replacement plan may be required, in case of transite pipe damages found during construction. This method is deemed the most cost effective way to meet the stations needs from a safety and reduction of risk of lost revenue perspective.

For Units 7/8, the pipe is considered to be in better condition, it does not require replacement at this time. A TMOD will be designed to tie the two unit 7 or unit 8 lines together into one active line upstream of a leak if there is a pipe burst.

Pros: This method requires minimal excavation efforts, reducing impact on other station services and interfacing System Structure & Components. It is also the most cost effective manner to fix the degraded pipe condition.

Cons: Possibility of damage to existing transite pipe. The transite pipe, which contains asbestos in its existing configuration, would need to be handled with care during installation.

Deliverables:	Associated Milestones (if any):	Target Date:
Previous releases:		
Completion of Preliminary Design Completion of Detailed Engineering for all 6 units Preparation of Execution partial Business Case Summary (BCS) and supporting documents for units 6, 1 & 8	Preliminary Design Detailed Engineering Partial Execution Release Business Case	2017-03-31 2017-11-30 2017-06-30
Completion of Detailed Design for all units	Detailed Design for all units	April – 2019
Completion of Planning and Assessing on all units	Planning and Assessing on all units	April – 2019
Completion of Procurement of long lead materials on all units	Procurement of long lead materials on all units	June – 2019
Completion of Construction for two units	Construction for two units	June – 2019
Current release:		
Complete Construction of the final two units excluding tie ins	Complete Construction of the final two units excluding tie ins	Dec – 2019
Complete the tie ins and AFS of Pickering A units	Complete the tie ins and AFS of Pickering A units	P2011 & P2041
Complete the tie ins and AFS of Pickering B units	Complete the tie ins and AFS of Pickering B units	Dec – 2019
Project Completion	Close Out	June – 2021

Key Risk Assessment — For Project Level A, B or C

Risk Class	Description of Risk	Response Type/ Actions/Final TCD	For Additional Review	Residual Ranking
Cost	There is a risk that the existing transite pipe and thrust block (TB) are damaged and condition of insulation is bad. This will add cost up and above the initial estimate as the plan is to re-use the existing transite pipe and thrust block with insulation in good condition.	Mitigate: • Perform an inspection of the transite pipe to ensure that it is in good condition. Have contingency plan in place to replace transite pipe if required. Projects will provide oversight and work with the vendor to assess the condition of TB and insulation material to determine the path forward. Contingency has been allocated for this risk. Risk for TB will be presented to PMOC. **Final TCD: [OCT-2019]**	No	Medium
Physcial/ Personnel Security	There is a risk that work is being carried out close to adjacent operating systems. Worker safety is at risk if there is some sort of pipe rupture or movement of the pipe during blowdowns.	Mitigate: • The lines will be isolated when the workers are performing removal/installation of BBD piping. Contractor will do adequate planning to minimize worker exposure. Safe work plan and permit will be in place, work authorization will be obtained. **Final TCD: [DEC-2020]**	No	Low
Environment	There is a risk that dewatering of the pits could result in a spill to the environment. There is also a risk of tritiated soil which may need to be quarantined and removed from site.	Mitigate Evaluate risk during design phase. Have safe work plans including adding barriers for Worker Safety, Environmental Safety plans prepared and spill kits to be available. Contingency has been allocated for this	No	Medium

Key Risk Assessment			For Project Level A, B or C	
Risk Class	**Description of Risk**	**Response Type/ Actions/Final TCD**	**For Additional Review**	**Residual Ranking**
		risk. **Final TCD: [SEP-2019]**		
Schedule	There is a risk that the outcome of Go or No Go assessment for the thermal hydraulic calculations results dictates that the current pipe supports cannot withstand the forces of blowing down both lines through a single line which requires reregistration with the TSSA adding additional project scope. Additionally this would require modifications to pipe supports to ensure they can handle blow down stresses.	Mitigate: Thermal Hydraulic (TH) analysis will be performed to confirm single line post installation can withstand the forces of blowdowns. TH analysis has been completed for Unit 1 which supports the single line configuration. This remains relevant to Units 4, 5, 6, 7 and 8. Contingency has been allocated for this risk. **Final TCD: [SEP-2019]**	No	Medium
Schedule	There is a risk that the heat tracing cables will get damaged while performing the tie-in work for the BBD pipelines. As a result an engineering modification would be required to replace the heat tracing cables.	Mitigate Test cables prior to removal to record as found conditions. Exercise caution while coiling back the heat tracing cables and reinstalling it. Test cables again after reinstallation. **Final TCD: [OCT-2019]**	No	Medium
Cost	There is a risk that a new vent line may be required in U1 due to known OPEX of water hammer. This would result in additional cost.	Mitigate Thermal Hydraulic (TH) analysis is completed for U1 with no issues found requiring a new vent line. P&M/OPS/Design will validate this during U1 commissioning. Contingency has been allocated for this risk. Risk will be presented to PMOC. **Final TCD: [JUL-2019]**	No	Medium

Type of PIR Report	Simplified/Standard PIR	**PIR Completion Date**	May-2021	
☐ Detailed PIR KPIs will be provided in future BCS(s) when Choose an item. Phase BCS release is requested.				
PIR KPIs	**Current Baseline**	**Target Result**	**How to measure?**	**Who will measure?**
Pipe failures in the newly installed Buried Boiler Blowdown piping.	Failure on U8 2013, and units 2 and 3 in the 1990s. Failure on unit 6 in 2017 resulting in TMOD EC 139038. Failure on Unit 4 in 2019.	Zero Pipe Failures in the newly installed pipe.	Through SCRs and System Health Reports	Performance Engineering/System Health Team

APPENDICES

Appendix A1: Summary of Estimate	Choose an item.									
Project Number:	**13-83072**									
Project Title:	**Buried Boiler Blowdown Pipe Replacement**									
$K	**LTD**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**Future**	**Total**	**%**
Project Mgmt	651	579	230	60					1,521	7%
Inspection									-	0%
Engineering	[redacted]									
Procurement										
Construction										
Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest										
Other										
Total	**4,941**	**14,481**	**1,366**	**160**	**-**	**-**	**-**	**-**	**20,948**	**100%**
Removal Costs (incl. above)									-	0%

Appendix A2: Summary of Estimate – Notes			
Escalation Rate	N/A	**Interest Rate (going-forward)**	4.35

Appendix A3: Summary of Estimate – In-Service Estimates				
$K	Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.			
Project #	**Date (YYYY-MM-DD)**	**Description**	**Amount**	**%**
83072	1/31/2020	First 2 units	[redacted]	50%
83072	12/31/2020	Last 2 units	[redacted]	49%
83072	6/30/2021	Project close out	[redacted]	1%
Total			[redacted]	100%

Prepared by:		Reviewed and Endorsed by:	
Dany Awad / Kamran Malik PNGS Design Projects Project Engineer / Project Manager	Date	Ahmed Smaili PNGS Design Project Section Manager	Date

Appendix B: Total Project Estimate Variance Analysis (Only required when more than one Execution Phase BCS; delete table if not applicable)									
$K	**LTD**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**Future**	**Total**
G3A EXEP	7,713	11,001	2,074	160					20,948
G3B EXEF	4,941	14,481	1,366	160					20,948

Total Project Estimate Variance Explanation (delete if not required)
There is no change in the Total Project Cost.