Pickering B Steam Generator Maintenance Waterlancing 13 - 40645

Full Release Business Case Summary NK30-BCS-36340-00004-R000

1/ RECOMMENDATION:

We recommend a Full Release of $25M (including contingency) to complete Water Lancing on all four Pickering B units from 2008 to 2010 as recommended in the Steam Generators Life Cycle Management Plan (LCMP) (NK30-PLAN-33110-10008), and the Steam Generator Investment Review (30 May 2006) (N-REP-33110-10018)

The business objectives of this project is to:

- Reduce / eliminate the risk of forced outages due to tube leaks caused by sludge build up.
- Reduce/eliminate the need for future Chemical Cleaning campaigns
- Maintain critical assets until units end-of-life

Under-deposit pitting due to sludge build-up is one of the main failure mechanisms causing tube leaks in the steam generators. A multifunctional Steam Generator Review team recently completed a study of this type of failure and came to the following conclusions:

- A Fitness for Service strategy of inspecting and plugging of tubes will allow us to operate all units until their current End of Life dates; however, this strategy will lead to a deteriorating and perhaps irreversible SG performance that will result in a large financial penalty and likely loss of regulatory credibility.
- The current Life Cycle Plan involving Water Lancing every four years will substantially reduce the likelihood of forced outages (under a Fitness for Service strategy) and will therefore provide a significant financial benefit.
- Other variations of the current LCP such as targeted and enhanced Water Lancing may provide marginally greater value but cost more and involve greater risk.
- Changes in this strategy should be considered if End of Life, Forced Loss Rate, and Planned Outage projections change significantly.

Based on the recommendations of this study we are therefore requesting approval of a Full Release of $25M to conduct Water Lancing on each PB unit from 2008 to 2010. Should further analysis or more definitive refurbishment / EOL dates suggest there is more value in an alternative strategy, we will submit a superseding BCS outlining the opportunities and risks.

$000's (incl contingency)	Funding	LTD 2006	2007	2008	2009	2010	2011	Later	Total
Currently Released	N/A								-
Requested Now	Full		486	6,318	11,487	6,287	395		24,973
Future Funding Req'd									-
Total Project Costs		-	486	6,318	11,487	6,287	395	-	24,973
Other Costs									-
Ongoing Costs									-
Grand Total		-	486	6,318	11,487	6,287	395	-	24,973
Investment Type: Sustaining		Class: OM&A		(IEV) Impact on Ec Value: 38.9M		IRR: N/A		Discounted Payback: N/A	

Submitted By:

P. Tremblay — April 15/07
Senior Vice President Pickering B — Date:

Finance Approval:

D. Power — April 25/07
Director Investment & Business Planning — Date:

Line Approval (Per OAR Element 1.1 Project in Budget):

J. Hankinson — 21/5
President & CEO — Date:

2/ BACKGROUND & ISSUES

The historic operating trends for Pickering B SGs have shown a correlation between the tube leak and intervals between chemical cleaning and Water Lancing. The historical data illustrate absence of tube leaks for several operating years after completion of effective cleaning campaigns followed by escalation in the frequency of tube leaks in the hot leg tube sheet region. The chief mechanism for this phenomenon is known to be under-deposit pitting corrosion. Effective Water Lancing is a cost effective method (as opposed to chemical clean) to remove accumulated sludge during operating intervals to mitigate under deposit pitting.

According to studies, the sludge piles that form in the SGs are generally "kidney shaped" piles with the peak located near the center of the hot leg bundle. Over time the peak heights increase and the pile spreads outwards the periphery and the No Tube Lane (NTL) of the SGs. In a short time, the central tubes are covered with sludge and are at higher risk. The current LCMP calls for Water Lancing every four years at a minimum to reduce the corrosive environment created by sludge piles.

New improvements made to Water Lancing system and inspection equipment have produced favorable results in recent campaigns (2005-2006). This was achieved through the development of Inter tube flushing lance for the removal of sludge in the shadow areas and improved inspection strips for cleaning assessment respectively. Implementation of different strategies and better understanding of sludge profile has provided valuable information to produce enhanced results as the process will be customized to the unit conditions. The expected window for Water Lancing during a 40 day outage is expected to be approximately 17 days. In the bidding process vendors will be requested to demonstrate their ability to produce maximum results during this fixed period. Assessment of vendors cleaning capabilities along with cost will be used as selection criteria.

A multidisciplinary team comprised of engineers, operating, maintenance, and financial expertise was asked to review the Steam Generator (SG) Life Cycle Management (LCM) strategy for Pickering B (PB) in order to produce a report that summarized investment options, costs, and risks to OPG. The objective was to provide sufficient information as input to the 2006 Business Plan and to unit refurbishment decisions.

3/ ALTERNATIVES AND ECONOMIC ANALYSIS

$ Millions	Base Case FFS Inspect/Plug All SGs every 2.5 yrs	Alt 1 Recommend Std. W / L All SGs every 4 yrs	Alt 2 Targeted Enhanced W/L only Bad SGs every 2 yrs	Alt 3 Enhanced W/L All SGs every 2 yrs	Alt 4 FFS Inspect/Plug All SGs every yr
Revenue					
OM&A					
Capital					
NPV (after tax)	-52.8	-13.9	-18.7	-35.2	-156.6
Impact on Economic Value (IEV)	N/A	38.9	34.1	17.6	-103.8

Note: All NPV calculations are based on executing the strategy being measured to EOL

Base Case: Fitness for Service (Minimum Inspection/Plugging every 2.5 years) - Not Recommended

The Base Case involves:

- minimum inspection / plugging to satisfy Fitness for Service requirements for a 2.5 year operating interval.
- No water lancing

We do not recommend the Base Case because, the multidisciplinary team concluded, in July 2006, that this strategy will allow us to operate all units until their current End of Life dates; however, it will lead to a deteriorating and perhaps irreversible SG performance that will result in a large financial penalty and likely loss of regulatory credibility.

Alternative 1 – Water Lancing ever four years (Current LCMP - Recommended

The recommendation involves:

- Standard inspection/plugging every 2 years
- Standard water lancing on all 12 SGs every 4 years

The conclusion of the team (July 2006) was that the current LCMP involving Water Lancing every four years is a sound strategy and should be followed. Although their analysis indicates that other strategies (namely targeted and enhanced Water Lancing) would generate marginally greater value, they cost more and involve greater risk. They also recommended that this strategy be reviewed should there be any change in End of Life, Forced Loss Rates or Planned Outage projections

Alternative 2 - Specific (Targeted) S.G. Life Cycle Management Plan - Not Recommended

This option involves:

- enhanced inspection/plugging (every 2 years) on "bad" steam generators
- enhanced water lancing on only "bad" SGs every two years

We do not recommend this strategy as it creates less value, the cost is higher and the risks are greater than the LCMP

Alternative 3 – Enhanced S.G. Life Cycle Management Plan - Not Recommended

This option involves:

- enhanced inspection/plugging every 2 years (per LCMP)
- enhanced water lancing on all 12 SGs every two years

We do not recommend this strategy as it creates less value, the cost is higher and the risks are greater than the LCMP

Alternative 4 – Fitness for Service (Minimum Inspection/Plugging every year) - Not Recommended

This strategy involves:

- minimum inspection / plugging to satisfy Fitness for Service requirements for a 1 year operating interval.
- No water lancing

This strategy is not recommended because it adds about 40 planned outage days per year (2 more outages per year). There is a risk regarding our capability to plan and resource 4 outages per year

4/ THE PROPOSAL

- Initiate a competitive bidding process in preparation of Water Lancing in planned outages in 2008-2010 for all Pickering B units. This may include but not limited to development of mock-up, on boiler equipment, sludge removal tool, qualification testing, new lancing flow diagram and registration.
- Assess vendor's proposal based on meeting acceptance criteria as outlined in the LCMP and award contract.
- Ensure all required materials/equipment and procedures are available for execution per outage milestones
- Ensure contractor is adequately trained for working at OPG nuclear sites
- Achieve Water Lancing cleaning results per EMD proposed scope
- Complete Water Lancing within the allotted budget and the Outage schedule

The requested amount of $25M is based on the estimated contracted cost and staffing levels required during preparation, execution and restoration phases of the previous Water Lancing campaigns. The validity of assumptions used for this estimate are confirmed using most recent Water Lancing campaigns (P681 and P671) OPEX.

5/ QUALITATIVE FACTORS

None other than stated in the Business Objectives.

6/ RISKS

Description of Risk	Description of Consequence	Risk Before Mitigation	Mitigating Activity	Risk After Mitigation
Cost				
Unexpected difficulties in equipment/flow diagram development and registration	Cost overrun	**High**	Monitoring and tracking contractor's preparation activities by OPG Projects	**Medium**
Scope				
Unable to complete scope during a fixed outage window	Inadequate tubesheet cleaning and increased risk of under deposit pitting as a result during the operation	**High**	Water lancing strategy will be customized to unit condition to maximize the effectiveness. Lessons learned from previous campaigns will be reviewed for improvements	**Medium**
Schedule				
Contract not awarded per P881 Outage Milestone due to the 2 year advancement of Unit 8 campaign and lack of funding	Not able to meet the Outage Milestone for P881 and delay in vendor's deliverables.	**High**	Boiler Projects staff will work closely with finance to ensure adequate funding is available to initiate a RFP for competitive bidding and award the contract in a timely manner for P881 execution.	**Low**
Station caused delays	Delay in Waterlancing onsite activities	**High**	Delays in Waterlancing schedule due to unforeseen station issues will be documented and communicated to outage management and recovery plans will be jointly developed. Review lessons learned from previous campaigns and improve alignment and awareness from station support.	**Low**
Delay in registration of Waterlancing process system (if new)	Unable to register and accept the new Waterlancing system	**High**	Boiler Projects will revie vendor's readiness for new system, and if necessary, sole sourcing the 1st unit execution (using the existing system) and competitively bidding the remaining units.	**Low**

Filed: 2013-09-27
EB-2013-0321
Ex. F2-3-3
Attachment 1 Tab 8

Resources				
Lack of skilled trades and technicians	Unfamiliarity with Waterlancing process and working at nuclear sites, compromising quality and schedule.	**Medium**	Contract will be awarded to allow sufficient time for staff training	**Low**
Technical				
Failure of qualification testing (if new system)	Insufficient cleaning due to modification of process parameters	**Medium**	Stakeholders will be involved in qualification testing from the early stages to ensure process is qualified and effective	**Low**
Site execution issues	Contractor work practices impacting equipment condition and outage duration	**High**	Management expectations will be rolled out to contractor prior to site execution to ensure event free tools are effectively practiced	**Low**
Regulatory				
No significant regulatory risks are expected.				
Environmental				
Spill due to hose rupture or fitting failure	Unplanned release of radionuclide through lancing waste water or breach of containment	**Medium**	These concerns will be considered during design phase of the system and accepted by OPG prior to site execution	**Low**
Health & Safety				
High pressure water jets and spread of contamination	Personnel injury. Unplanned dose uptake	**Medium**	Use of mock up for training and implementing procedural barriers	**Low**
Investment				
No significant risk is expected				

Filed: 2013-09-27
EB-2013-0321
Ex. F2-3-3
Attachment 1 Tab 8

Filed: 2013-09-27
EB-2013-0321
Ex. F2-3-3
Attachment 1 Tab 8

7/ POST IMPLEMENTATION REVIEW PLAN

Type of PIR:	Targeted Final AFS Date:	Targeted PIR Approval Date:	PIR Responsibility (Sponsor Title)
Simplified	Dec 2010	Jun 2011	Manager Pickering B Components and Equipment Department

Comments:

	Measurable Parameter	Current Baseline	Targeted Result	How will it be measured?	Who will measure it? (person / group)
1.	Cleaning effectiveness	Post water lancing results form previous campaigns	Removal of soft sludge snd returning SGs to post Waterlancing conditions of previous campaigns between 2005 and 2006	Visual inspection of pre and post Waterlancing of the same SG	Engineering Mechanics Department and IMS
2.	Tube pitting indications	Results from previous inspection	Comparable to recent histotrical data	Eddy Current inspection per the SG LCMP	Engineering Mechanics Department and IMS
3.					
4.					
5.					

Filed: 2013-09-27
EB-2013-0321
Ex. F2-3-3
Attachment 1 Tab 8

Appendix "A" Glossary (acronyms, codes, technical terms)

EOL: End of Life
LCMP: (Pickering B Steam Generator) Life Cycle Management Plan
NTL: No Tube Lane
SG: Steam Generator
SMB: Site Management Board

Filed: 2013-09-27
EB-2013-0321
Ex. F2-3-3
Attachment 1 Tab 8

Appendix "B" — Project Funding History

$ 000's Release Type	Month	Year	2006	2007	2008	2009	2010	2011	2012	Later	Total
		All Existing and Planned Releases (incl contingency) Cumulative Values									
Full				486	6,318	11,487	6,287	395			24,973
											0
											0
											0
											0
											0
											0
											0

LTD Spent											0

Comments:

Filed: 2013-09-27
EB-2013-0321
Ex. F2-3-3
Attachment 1 Tab 8

Appendix "C" Financial Model – Assumptions

See the Pickering B Steam Generator Investment Review N-REP-33110-10018 (Sections 5)

Filed: 2013-09-27
EB-2013-0321
Ex. F2-3-3
Attachment 1 Tab 8

Pickering B Steam Generator Maintenance Waterlancing 13 - 40645

Full Release Business Case Summary NK30-BCS-36340-00004-R000

Attachment "A" **Project Cost Summary**

$000's OM&A	LTD Prior Yr	This Release 2007	This Release 2008	This Release 2009	This Release 2010	This Release 2011	Future Release	Later	Total
Project Management (OPG)		314	314	392	314	235			**1,569**
Engineering & Drafting (OPG)		20	40	20	10	8			**98**
Material			2	3	1				**6**
Installation – PWU, BTU		102	426	812	426	102			**1,868**
Contract - Design									**-**
Contract - Installation			4,677	8,843	4,677				**18,197**
Contract - Other			209	417	209				**835**
									-
									-
Interest (Capital Project Only)									**-**
Project Costs (excl contingency)	**-**	**436**	**5,668**	**10,487**	**5,637**	**345**	**-**	**-**	**22,573**
General Contingency		50	650	1,000	650	50			**2,400**
Specific Contingency									**-**
Project Costs (incl contingency)	**-**	**486**	**6,318**	**11,487**	**6,287**	**395**	**-**	**-**	**24,973**
2006-2010 Business Plan			1,000	11,000	12,000				**24,000**
Variance to Business Plan	**-**	**436**	**4,668**	**(513)**	**(6,363)**	**345**	**-**	**-**	**(1,427)**
Committed Cost		18,197	(4,677)	(8,843)	(4,677)				**-**
Inventory Write Off Required									**-**
Spare Parts / Inventory									**-**
Total Release (excl contingency)	**-**	**18,633**	**991**	**1,644**	**960**	**345**	**-**	**-**	**22,573**
Total Release (incl contingency)	**-**	**18,683**	**1,641**	**2,644**	**1,610**	**395**	**-**	**-**	**24,973**

Ongoing OM&A (non-project)									**-**
Removal Costs (incl in above)									**-**

Basis of Estimate					
Design Complete	N/A		Quality of Estimate	Release + 15% to - 10%	
3rd Party Estimate	No	OPEX used	Yes	Lessons Learned	Yes
Reviewed by Sponsor	Yes	Budgetary Quote(s)	No	Phase 1 Actual Used	Yes
Similar Projects	Yes	Contracts in place	No	Competitive Bid	Yes

Variance to Business Plan

The estimated variance(s) to the 2006-2010 Business Plan will be addressed through the portfolio management process. A PCRAF will be approved by Apr 2007.

Reviewed By: 10 APR / 2007
P. Asgaripour
Project Manager
Date:

Approved By: 10 Apr 07
J. Keto
Eng & Mods Manager (Strat IV)
Date:

Pickering B Steam Generator Maintenance Waterlancing 13 - 40645

Full Release Business Case Summary NK30-BCS-36340-00004-R000

Attachment "B" **Project Variance Analysis**

	LTD N/A N/A	Total Project Last BCS N/A N/A	Total Project This BCS N/A N/A	Variance	Comments
Project Management (OPG)				0	
Engineering & Drafting (OPG)				0	
Material				0	
Installation – PWU, BTU				0	
Contract - Design				0	
Contract - Installation				0	
Contract - Other				0	
				0	
				0	
Interest (Capital Project Only)				0	
Project Costs (excl contingency)	**0**	**0**	**0**	**0**	
General Contingency				0	
Specific Contingency				0	
Project Costs (incl contingency)	**0**	**0**	**0**	**0**	
Committed Cost				0	
Inventory Write Off Required				0	
Spare Parts / Inventory				0	
Total Release (incl contingency)	**0**	**0**	**0**	**0**	
Total Release (excl contingency)	**0**	**0**	**0**	**0**	

Ongoing OM&A (non-project)				**0**	
Removal Costs (incl in above)				**0**	

Comments:

Attachment "C" **Key Milestones**

Completion Date			Description
Day	Mth	Yr	
15	05	2007	Full Release BCS approved
30	06	2007	Waterlancing contract awarded
18	02	2008	Unit 8 Waterlancing start
27	03	2008	Unit 8 Waterlancing complete
15	04	2008	Unit 8 Available for Service
09	03	2009	Unit 5 Waterlancing start
05	04	2009	Unit 5 Waterlancing complete
11	04	2009	Unit 5 Available for Service
02	11	2009	Unit 6 Waterlancing start
29	11	2009	Unit 6 Waterlancing complete
10	12	2009	Unit 6 Available for Service
01	11	2010	Unit 7 Waterlancing start
28	11	2010	Unit 7 Waterlancing complete
02	12	2010	Unit 7 Available for Service
31	05	2011	Project close-out complete

A Project Execution Plan (PEP) will be approved by Sep 2007

Comments: