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Station:	Project Name:	Project No.:	Units:	Controlled Doc No.:
Darlington	Sally Port Physical Barrier System Upgrades	10-25918	Not applicable.	D-PIR-61400-10000

Approval	Cost	Date
Original Approval Estimate	10,745K	31/05/2017
Approval Revision Estimate		
Final Approval Estimate	10,745K	31/05/2017
Final Actual Project Cost	10,485K	01/06/2018

Timing	
Target Date	31/08/2017
Latest Approved i/s Date	07/24/2018
In Service Date	04/12/2017
Period used to calculate Performance result	08JAN2019 - 12FEB2020

DELIVERABLES	
Target	**Achievement**
New physical barrier system fence at the Sally Port meets the delay and assessment criteria stated in the nuclear security regulations. TCD: August 31, 2018	New section of physical Barrier System Fence installed, additional detection and assessment capability available.
QUALITATIVE RESULTS	
Functional testing of fence for detection and assessment capability criteria stated in the Nuclear Security Regulations TCD: August 31, 2018	Work completed, testing and commissioning completed successfully.
KEY LESSONS	
N/A	N/A
FOLLOW-UP ACTIONS	
N/A	N/A

Prepared by:
Stephen Prior
Signature (Author) — Date: 02/25/2020

Reviewed by:
Brian Osboure
Signature (Project Sponsor) — Date: FEB 25, 2020

~~Prepared by:~~
Reviewed by:
Brett Lemmon
Signature (Project Approval Authority - Finance) — Date: Mar 20, 2020

Approved by:
Steve Gregoris
Signature (Project Approval Authority) — Date: April 1, 2020

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ONTARIO POWER GENERATION	Document Number: FIN-TMP-PA-002*	Revision: R02	Page: 1 of 2
	POST IMPLEMENTATION REVIEW TEMPLATE (For Simplified PIRs only)		

Station: Darlington NGS	Project Name: TRF CRS Hydrogen Compressor Condition Monitoring	Project No.: 16-31410	Units: TRF	Controlled Doc No.:

Approval	Cost	Date
Original Approval Estimate	$6,624k	Apr 1, 2015
Approval Revision Estimate	$6,624k	April 16, 2015
Final Approval Estimate	$7,302k	Aug 17, 2015
Final Actual Project Cost	$6,943k	Oct 11, 2017

Timing	
Target Date	May 31, 2016
Latest Approved i/s Date	Sept 28, 2017
In Service Date	Sept 28, 2017
Period used to calculate Performance result	1/1/2020

DELIVERABLES

Target	Achievement
Extended Operating period between TRF outages	Not achieved. Failure of 0-39440-CP3401 after 2,000 hours in 2019 has not allowed for extended run. Not project related.
The new condition monitoring system operates without failure.	A single cross head vibration sensor failed and had to be replaced during the first 24 months of service (WO 05239740). Pressure transmitter data as presented in VISU has discovered to have an error in the displayed value. The fix is being reviewed with the Vendor.
No false trips or spurious alarms resulting from new condition monitoring equipment.	Spurious alarms experienced due to multiple pressure sensors being wired improperly.
TRF personnel have compressor condition data available to determine if longer TRF operational runs are possible.	Met Target.

QUALITATIVE RESULTS

Install a proven, real-time condition monitoring system on the CRS Hydrogen Compressors	Real-time condition monitoring system was installed and commissioned on the CRS Hydrogen Compressors which is now providing station personnel with the capability to continuously monitor, trend and diagnose critical parameters such as cylinder pressure, valve temperatures, bearing temperatures, frame vibration, crosshead acceleration and piston proximity.

KEY LESSONS

Procedure updates	Procedure updates need to be a requirement for closing out a project. As of June 16, 2020, Control Maintenance procedure NK38-CMP-63944-01 has not been processed.

Sensor calibration	Various sensors have an offset error, which was not detected during commissioning. This offset is a simple software offset and should have been detected and resolved before turnover. Verification of field sensor accuracy should be better controlled by the project.
FOLLOW-UP ACTIONS	
None required	N/A

Prepared by: George Carlin Date: 10 Jul 2020
Author

Reviewed by: T DeBruijn Date: 10 Jul 2020
Project Sponsor

Approved by: Brett Lemmon Date: July 12, 2020
Project Approval Authority Finance

Approved by: Date: 14-Jul-2020
Project Approval Authority

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ONTARIO POWER GENERATION

Records File Information:
For all projects, file in accordance with local project management governance
For capital projects, send a copy to Shared Financial Services/Asset Accounting
For PIRs, refer to OPG-PROC-0056; Retention: P

Internal Use Only

FIN-FORM-PA-005-R005*

Project Closure Report

This Project Closure Report (PCR) form is used for documenting relevant project closure information and approving the project closure decision in accordance with FIN-PROC-0030. It may also be used as a Post Implementation Review (PIR) report in accordance with OPG-PROC-0056, Post Implementation Review.

Part 1: Project Account Closure – Complete for all projects	
Is this PCR also used as a PIR report? Yes	**Records Document Number** (required only when the PCR is also used as a PIR report)
Project Executing Organization Darlington Projects and Modification	**Date** March 10, 2021
Project Number 16-31522	**Site / Location Name** Darlington Nuclear Generating Station, Tritium Removal Facility
Project Title Tritium Removal Facility Deuterium Makeup System Electrolyzer Replacement	
Project and Asset (if any) Description Project 16-31522: DN Tritium Removal Facility Deuterium Make-Up System Electrolyzer Replacement Project The scope of this project is to remove and replace the Deuterium Make-Up System Electrolyzer in the Tritium Removal Facility.	
Company Code / Business Area (Controller) 9807	**Asset Class (Controller)** 15370000
Super Asset Number (Controller) 65934	**Super Asset Description (Controller)** Darlington Station - Tritium Removal Facility

Part 2: Final In-Service Transfer – Complete for CAPITAL projects
Final In-Service Transfer Credit Account (Controller)

Part 3: Project Cost and Schedule Variance – Complete for all projects				
	(1) Original Approved Estimate	**(2) Current Approved Estimate**	**(3) Final / Actuals**	**(4) Variance (= 3 – 2)**
Cost ($K)	3,218.00	14,525	14,244	(281)
Schedule (In-service date)	2015-04-15	2017-08-30	2019-11-02	109 weeks behind schedule
Deliverables (Completed? Intended Functionality Achieved? Target vs. Actual?)				

*Associated with FIN-PROC-0030, Property, Plant and Equipment

ONTARIO POWER GENERATION

Records File Information:
For all projects, file in accordance with local project management governance
For capital projects, send a copy to Shared Financial Services/Asset Accounting
For PIRs, refer to OPG-PROC-0056; Retention: P

Internal Use Only

FIN-FORM-PA-005-R005*

Project Closure Report

Deliverables:

1) Design, procurement, construction, and commissioning to replace the existing DMS electrolyzer unit. The result of this project is

- A secure supply of deuterium gas for the remaining life of the plant
- An increase in the safety and robustness of the deuterium gas supply
- Significant decrease in the number of functional failures associated with the deuterium make-up system

Completion target:

Original BCS projected an Available For Service (AFS) during T1501 Outage (April 21, 2015). Final AFS was achieved on October 2, 2019.

References or attached pages for:

- Listing in chronological order of all corresponding BCSs and of variance approvals – date and approval authority; and what approved – cost, schedule, and deliverables
- Reference the "lessons learned report"
- Discussion and analysis – cost, schedule, deliverables, and key lessons learned

Turnover Declaration: MOD 120138

Adobe Acrobat Document

BCS attached below;

Lessons learned report: NK38-LLD-39330-10000: Lessons Learned in TRF Deuterium Makeup System Electrolyzer Replacement Project

Part 4: PCR Approval Signatures – Complete for all projects

Project Manager: The project is declared closed. I confirm that all remaining materials (if applicable) of the project are appropriately dispositioned as spare parts to accepting business areas or are declared surplus. No costs shall be charged to this project at this point forward.

Controller for Project Organization (if applicable, i.e., the BU/Function has a Project Organization Controller): I confirm the information documented in this PCR is correct.

PCR Submitted by: Project Manager	**PCR Reviewed by: Controller for Project Executing Organization** (if applicable)
Susan Treki	24Mar21
Susan Treki Project Manager, Darlington Projects and Modifications **Date** March 11, 2021	Name Shawn Klis - P&M Controller Title, Department, BU/Function **Date**

*Associated with FIN-PROC-0030, Property, Plant and Equipment

Project Closure Report

Station / Plant Group / Function Controller: I confirm the information documented in this PCR is correct. **Asset Owner:** I authorize the decision to declare project closure for this project.	
PCR Reviewed by: Controller for Sponsoring Organization Brett Lemmon Name Brett Lemmon - Station Controller Title, Department, BU/Function **Date** Mar 25, 2021	**PCR Approved by: Asset Owner or Sponsoring Organization Authority** Richard Geofroy for Name Steve Gregoris - SVP, Darlington Title, Department, BU/Function **Date** March 29, 2021

Part 5: PIR Signature – Required only when the PCR is also used as a PIR report		
	Signature	**Date**
I have reviewed and accept the PIR results in this report.		
Reviewed by: Project Sponsor Richard Geofroy for Name Steve Gregoris SVP, Darlington Title, Department, BU/Function		March 29, 2021

Part 6: Distribution – Required only when the PCR is also used as a PIR report

Distribution:

When this PCR is also used as a PIR report, the Project Sponsor shall ensure distribution (cc) to the following personnel if they have not already signed off above:

- Finance Approver in the BCS: Name, Title, Department, BU/Function
- Line Approver in the BCS: Name, Title, Department, BU/Function
- Other key stakeholders:
  Name, Title, Department, BU/Function

Part 7: PCR Checklist – Complete for all projects by Project CSA or Project Manager	
Checklist Item	**Checkbox**
All Tempus Work Events have been closed, including: • Assigned Tempus Work Events • AS7 Work Order Task created work events	 ☒ ☒
All PO/WO/MRs/CRs have been closed, including: • Request sent to AS7 buyer to close PO/COs after closing related MRs/CRs • Request sent to Planner to close any AS7 Work Order Tasks NA • Request sent to ONCORE to close all tasks and associated PO's NA	 ☒ ☒ ☒
All Accruals have been cleared.	☒
Any purchases through purchasing cards (VISA) or Ariba Web Catalogue have been reconciled in Concur or shipped by Ariba Vendor. NA	☒
All default Business Expense or VISA default accounts have been changed. NA	☒
All spare parts have been set up in AS7, including: • Inventory by Cat ID with ROP/TMAX values • Capital Spares are set up in the appropriate Asset Class and account	 ☒ ☒
All obsolete or surplus inventory or components have been identified and Surplus Declarations routed to ensure that all retired assets have been properly removed from the fixed asset ledger and inventory accounts.	☒
The Super Asset Class, the Company Code, Super Asset Numbers agree with previous REIS.	☒
The Final Actual Costs and Current Approved Estimate agree with FRA and/or SAP.	☒
If this is combined PCR/PIR, it was defined in the approved BCS.	☒
If the Actuals are greater than the Approved amount, the overspend has been approved in accordance with the appropriate OAR Element specified in the BCS standard (OPG-STD-0076, Developing and Documenting Business Cases), with an approved OPG-FORM-0077, Project Over-Variance Approval or a Superseding BCS. NA	☒
A copy of the FRA and/or SAP Report is attached.	☒

Project CSA / Project Manager (Sign-Off): I confirmed the completion of all the checklist items.		
Project CSA or Project Manager Susan Treki Nuclear Projects, Darlington Projects 2	**Signature** Susan Treki	**Date** March 11, 2021

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	POST IMPLEMENTATION REVIEW TEMPLATE (For Simplified PIRs only)		

Station:	Project Name:	Project No.:	Units:	Controlled Doc No.:
Darlington	MOT/UST/10MVA Transformer Storage Facility	16-31530	1-4	D-PIR-22500-00001

Approval	Cost	Date
Original Approval Estimate	$5,631k	2016-02-05
Approval Revision Estimate	$6,622k	2016-12-23
Final Approval Estimate	$6,752k	2016-12-23
Final Actual Project Cost	$6,606.5k	2017-04-21

Timing	
Target Date	2016-09-30
Latest Approved i/s Date	2016-09-30
In Service Date	2017-04-21
Period used to calculate Performance result	29 weeks

DELIVERABLES	
Target	**Achievement**
Storage for 4 MOT's, 1 UST, and one 10MVA distribution transformer.	Storage space has been provided for 4 Main Output Transformers (MOT), 1 Unit Service Transformer (UST), and one 10MVA distribution transformer.
Any of the transformers can be transferred to the applicable unit within 5 days.	It was confirmed during the Project that any of the transformers can be transferred to the applicable unit within 5 days.
Location of storage facility minimizes impact on Operator routines and periodic maintenance on the spare transformers.	It has been confirmed that the location of the new spare transformers does not impact the Operator routines and periodic maintenance on the spare transformers.

QUALITATIVE RESULTS	
Deliverables	All deliverables on this project have been completed and confirmed to meet the design requirements. The facility was made available in time for the newly purchased transformers with only minor delays.

KEY LESSONS	
Financial	Original Project Start in 2015 was moved to 2016 due to budgetary issues. The rush to complete installation in time for transformer delivery on Capital Spares Project 16-36002 led to rework and cost overruns and impact on Project 16-36002.

Project Management	Because civil design was performed by OPG and not part of the contract, the EPC vendor employed civil engineers who were not design qualified, which led to rework and cost overruns. When civil design is not part of an EPC contract, the contract must clearly stipulate the qualification required of the contractor civil engineers and their non-design responsibilities.
FOLLOW-UP ACTIONS	
	None.

Prepared by: R. Uraisami Date: 5FEB 2020
Rob Uraisami
Section Manager – Electrical
Darlington

Reviewed by: Julia Petrie Date: Feb. 5, 2020
Julia Petrie
Manager, Performance Engineering
Darlington

Approved by: Brett Lemmon Date: Jun 15, 2020
Project Approval Authority Financel Authority

Approved by: Z. Khansaheb Date: Feb 7, 2020
Zar Khansaheb
Director, Station Engineering
Darlington

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	POST IMPLEMENTATION REVIEW TEMPLATE (For Simplified PIRs only)		

Station:	Project Name:	Project No.:	Units:	Controlled Doc No.:
Darlington	DCC Obsolete Component Replacement	16-33509	014	D-PIR-69000-10003

Approval	Cost	Date
Original Approval Estimate	$8,095	SEP-2003
Approval Revision Estimate	$8,577	JUN-2005
Approval Revision Estimate	$8,739	OCT-2006
Approval Revision Estimate	$8,737k	JUL-2007
Approval Revision Estimate	$8,855k	JAN-2009
Approval Revision Estimate	$8,655k	JUL-2010
Approval Revision Estimate	$8,955k	JUN-2011
Approval Revision Estimate	$8,844k	OCT-2012
Approval Revision Estimate	$9,112k	MAY-2014
Approval Revision Estimate	$9,408	AUG-2015
Approval Revision Estimate	$9,459k	SEP-2016
Approval Revision Estimate	$9,458k	NOV-2017
Final Approval Estimate	$9,608k	OCT-2018
Final Actual Project Cost	$9,599	JUN-2019

Timing	
Target Date	JUN-2019
Latest Approved i/s Date	JUN-2019
In Service Date	JUN-2019
Period used to calculate Performance result	Q42000-Q32002 vs Q22018 – Q12020

DELIVERABLES

Target	Achievement
Corrective Maintenance Time – 30% Reduction	The 2002Q3 health report did not report the number of corrective/deficient/preventative maintenance work order or time it took to execute these types of maintenance. Instead, an overall indicator of DCC unavailability was reported. In 2002Q3 health report, it reported unavailability average of 12.13 hours/DCC/quarter. In the 2020Q1 health report, the unavailability average is 4.04 hours/DCC/quarter. Note that this number reflects the DCC maintenance hours only and does not include DCC unavailability due to planned extended DNRU2 bus outages. This is a 67% reduction. A review of components replaced by the project indicated more than 30% reduction of Corrective Maintenance:

	• CPU Power Supplies: From 2000Q4 to 2002Q3, there were 21 fault events that required corrective maintenance. From 2018Q2 to 2020Q1, there were no CPU Power Supply events. • MHD/TE-16 Drives: From 2000Q4 to 2002Q3, there were 14 fault events that required corrective maintenance. From 2018Q2 to 2020Q1, there were 3 events. • DUC/DUSC: From 2000Q4 to 2002Q3, there were 120 fault events that required corrective maintenance. From 2018Q2 to 2020Q1, there were 2 events.
Preventative Maintenance Time – 50% Reduction	The 2002Q3 health report did not report the number of corrective/deficient/preventative maintenance work order or time it took to execute these types of maintenance. Instead, an overall indicator of DCC unavailability was reported. In 2002Q3 health report, it reported unavailability average of 12.13 hours/DCC/quarter. In the 2020Q1 health report, the unavailability average is 4.04 hours/DCC/quarter. Note that this number reflects the DCC maintenance hours only and does not include DCC unavailability due to planned extended DNRU2 bus outages. This is a 67% reduction.
Contribution to DCC Stalls – 50% Reduction.	In the 2002Q3 health report, it noted 119 DCC/CPC stalls in a 2 year period (from 2000Q4 through 2002Q3). It was noted that at least 10-15% of the stalls (i.e. 12-18) were due to issues the project addressed (e.g. memory issues). In the latest 2020Q1 health report, there were 4 DCC/CPC stalls in a 2 year period (from 2018Q2 through 2020Q1). Two of these stalls were related to the DURC controller. This is a 83-89% reduction.

QUALITATIVE RESULTS	
Technical Support Available for long term support	System design of the replacement components was carried out by OPG staff. The Computer and Control Design Department retains design responsibility, knowledge and expertise to provide long term support.
Spare Parts	Sufficient spare parts were procured to maintain design for life of station.
Schedule Performance	Schedule was extended several times, resulting in 8 years of delay. Upfront planning and elimination of scope creep is required to eliminate these schedule delays.
Cost Performance	Cost was increased several times. Upfront planning and elimination of scope creep is required to eliminate cost increased. Increased contingency is required to accommodate fluctuating compenent costs on the international market.

KEY LESSONS	
Improved estimates for computer replacement projects	Lessons learned on the DCC Obsolence project contributed to imporved estimates for the DCC, CP and SEM aging management project and the FH aging management project. This project was the first iteration of reverse engineering by our vendor partners and estimating lessons learned were incorporated into similar projects to narrow the vendor design costs estimates.

Improved preliminary engineering products for reverse engineering	Improved engineering and technical specifications to ensure quality engineered products. Requiring a vendor to develop a reverse engineered product from a requirements document that simply stated "make the new one the same as the old one" was insufficient and led to poor quality.
FPGA development standards for engineered products	Develop standard for FPGA based designs to use a software development QA program for firmware development. IEC standard is in progress. All FPGA development now follows a software development process and QA program.
Project Management	This project had 6 different PMs over the lifecycle of the project. Migrating future projects to the PMO model will improve project performance.
FOLLOW-UP ACTIONS	
NA	All Issue Tracking File (ITF) actiosn have been completed. No futher actions are required.

Prepared by: Bryon Engelage
Bryon Engelage
Project Leader II
Computers and Controls Design

Date: July 23, 2020

Reviewed by: NANA
Nana Osei Addae
Section Manager
Computers and Controls Design

Date: 23Jul2020

Reviewed by: David Rogalski
David Rogalski
Sr Manager
Computers and Controls Design

Date: 30 July 2020

Approved by: Brett Lemmon
Brett Lemmon
Finance Controller, Darlington

Date: 30 July 2020

Approved by: Z. Khansaheb
Zar Khansaheb
Director, Station Engineering
Darlington

Date: 30July2020

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ONTARIO POWER GENERATION	Document Number: FIN-TMP-PA-002*	Revision: R02	Page: 1 of 4
	POST IMPLEMENTATION REVIEW TEMPLATE (For Simplified PIRs only)		

Station: Darlington	**Project Name:** Partial Discharge Monitoring (PDM) Project	**Project No.:** 16-33623	**Units:** Units 0, 1, 2, 3, 4	D-PIR-33130-10001, Rev000

Approval	Cost	Date
Original Approval Estimate (Unit 0, 1, and 3 only)	$2,438K	May 2009
Approval Revision Estimate	$0	N/A
Final Approval Estimate (including contingency)	$7,147K	June, 2011
Final Actual Project Cost (Unit 0, 1, 2, 3, & 4)	~~$5,660K~~ $5,640K	November, 2014

Timing	
Target Date	Unit 0 – 2011 Unit 1 – D1111 Unit 3 – D1231 Unit 4 – D1341 Unit 2 – D1321
Required Service Date	Same as above
In Service Date	Unit 0 – Sept 2011 Unit 1 – Sept 2011 Unit 3 – Aug 2012 Unit 4 – Aug 2013 Unit 2 – Mar 2014
Period used to calculate Performance result	2011-2014

DELIVERABLES	
Target	**Achievement**
Establish PD baseline for all PHT Pump Motors and Main Generators.	The new PDM system for the PHT Pump Motors & Main Generators met this target with no issue. The PDM system was successfully installed on all four units during planned outages (D1111, D1231, D1341 and D1321) and baseline data on all pump motors and generators was collected after unit start ups. The data is stored on a laptop that was purchased with the PD software pre-installed.
Establish trend of all PHT Pump Motors and Main Generators using real time data.	The PDM project met this target with no issue. Trends for all PHT Pump Motors and Main Generators are in effect. PMID 130509-01 has been created to collect PD data on all PHT Pump Motors and Main Generators every six months. Data collected is stored on a laptop and then transferred to a common drive. Control Maintenance staff is required to email the data to station engineering for their review. This step is included in their PD data collection procedures for the PHT pump motors and main generators.
Determine a refurbishment strategy for the PHT Pump Motors and Main Generators using the PD data collected	The new PDM system for the PHT Pump Motors & Main Generators is being used to meet this target with no issue. PD data collected from the PHT pump motors is being used by station engineering to determine the condition of the winding insulation on each motor. Project 16-73564 has been initiated to replace/refurbish the PHT pump motors as per station engineering's recommendations.

Update existing / Create new documentation as required.	The PDM project has met this target with no issue. NK38-CMP-60000-02- Data Collection of Partial Discharge from PHT Motors, is approved for use in Passport. NK38-CMP-42100-03 - Partial Discharge Data Collection for Main Generator, is approved for use in Passport. Flowsheets NK38-FXX-42200-X501 (X = 1,2,3,4), Generator Excitation 42200-ex, have been updated for all four units to include the PDM system
Update maintenance requirements	The PDM project has met this target with no issue. NK38-CMP-63313-01, Replacement of Partial Discharge EMC Coupler from the PHT Motor (with taping instructions), is approved for use in Passport. NK38-CMP-51150-01, IPB Bus Link Removal and Installation, has been updated to include steps for matchmarking the IPB links prior to disconnecting the PDM cables during station maintenance activities on main generators. This will ensure that the PDM cables are connected to the same links after maintenance activities are complete.

QUALITATIVE RESULTS	
Onling PD data collection	The PDM system installed on PHT pump motors and main generators is capable of providing accurate PD data while the unit is in operation. As a result, data collection is scheduled every six months under PMID 130509-01.
PD data collection equipment and procedures	The PD data collection equipment is user friendly with appropriate and field verified procedures in place. Control Maintenance staff has been fully trained to use this equipment and they are able to store this data on the laptop and on common drive properly. The PD data collection procedures for PHT pump motors and main generators include a step for control maintenance to email the data to station engineering for review.
Installation Quality	The quality of each installation was verified by OPG's field engineering technicians and the equipment vendor's representative. Issues identified were resolved in a timely manner prior to returning the PDM equipment in service. Detailed Available For Service and Commissioning reports were also issued for each installation to document the analysis of baseline PD activities of stator windings for each machine. The baseline data was collected at full power and all reports can be found in Asset Suite under Project EC 112902, Ref Docs panel.

KEY LESSONS	
Verification of station procedures prior to field execution SCR D-2011-00500	Test run of the spare PHT pump motor, 0-33130-PM5, for commissioning could not be completed as per project schedule as Operators identified numerous deficiencies with the procedure, NK38-OTP-33130.01, which was being used to run the motor. It is recommended for future installations that the workplan preparer familiarizes themselves with station procedures that are to be used during installation and commissioning. Questioning attitude should be applied and any potential issues should be discussed and resolved with station personnel prior to start of installation.

Provide written directions to contractor to avoid miscommunication in the field SCR D-2012-03625	It was discovered that the existing wiring cable clips and studs (spot welded) on 3-33130-PM3 were rusted and in some cases broken right off from the wiring harness running from the CT enclosure to the control junction box. Therefore, new clips were required to install PDM cables inside the motor casing. The location of the new holes had been discussed between Design Engineer, Field Engineering and the contractor prior to drilling. DE had identified the hole locations should be closer to the edge of the brace so drill filings can be retrieved easily. However, there were no written directions or a sketch provided, so actual drilling occurred into an enclosed portion of the brace and filings could not be retrieved. Proper and accurate communication is crucial, especially when crews change every shift. It is strongly recommended to provide any such directions in writing as per so information can be forwarded correctly and completely to the incoming crew to prevent errors in the field.
Build scaffold for non-rad work after the surrounding rubber area has been declared out-of-service No SCR submitted	During D1111, PDM scaffold was built inside the rubber area following seal work for 1-33130-PM2 and PM4. As a result, PDM workers were required to work in plastic suits which was not required for this installation. It would have increased project costs significantly and delayed the project schedule in an outage. Therefore, it was determined to remove the scaffold, remove the rubber area from service and then re-build the scaffold to allow a smooth PDM installation. In future, any non-rad work inside a rubber area should be planned and executed after the rubber area is removed from service. Doing so will keep the project costs under control and installation activities more straight forward.
FOLLOW-UP ACTIONS	
N/A	There are no follow up actions associated with this project. All Action Tracking items have been completed and closed out.

Prepared by: Shruti Khanna
Project Leader

Date: Nov 5/2014

Prepared by: Larry Ip
System Engineer, Main Generator

Date: 1 25/2014

Prepared by: J. Schwartzel
Component Engineer, PHT Pump Motors

Date:

Uploaded on 15 Dec. This document may have been revised since it was printed. Approved control version posted on the intranet.

Reviewed by: ~~Dave Burger~~ Kit Leung
Project Sponsor

Date: June 5, 2018

Approved by: Electronically Approved by Steve Wiacek on behalf of George Turner
~~Carla Carmichael~~ George Turner
Project Approval Authority Finance

Date: June 12, 2018

Approved by: Electronically Approved by Zar Khansaheb on behalf of Brian Duncan
Brian Duncan
Project Approval Authority

Date: June 13, 2018

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ONTARIO POWER GENERATION	Document Number: FIN-TMP-PA-002*	Revision: R02	Page: 1 of 2
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Station: PNGS	Project Name: PNGSB Main Generator AVR and Protective Relay Upgrade	Project No.: 13-40680	Units: 5-8	Controlled Doc No.:

Approval	Cost	Date
Original Approval Estimate	15.939M	02/22/2010
Approval Revision Estimate	16.662M	01/10/2013
Final Approval Estimate	18.755M	12/19/2013
Final Actual Project Cost	18.691M	2/16/2016

Timing	
Target Date:	
U5	06/2013
U6	12/2013
U7	02/2015
U8	05/2014
Latest Approved i/s Date:	
U5	06/2013
U6	12/2013
U7	02/2015
U8	05/2014
In Service Date:	
U5	08/2013
U6	05/2014
U7	02/2015
U8	05/2014
Period used to calculate Performance result	First install-Present

DELIVERABLES	
Target	**Achievement**
Address the degradation/system reliability and availability of the Automatic Voltage Regulator (AVR) and Protective Relay System of the PNGS B Main Generators	No reliability issues/failures with AVRs or Digital Protective Relays since installation.

QUALITATIVE RESULTS	
Production and Reliability	Once commissioned, no forced loss rate or outage extensions due to the AVRs and Digital Protective relays.

KEY LESSONS	
SCR P-2013-09118	B1 SCR, when the MOT was backfed in support of 4kV transfer test it tripped 3 times on overvoltage protection causing 30 day hit to critical path. Root cause was change in secondary impedance on PTs from electromechanical to digital relays and required
FOLLOW-UP ACTIONS	
None	

TITLE Post Implementation Review Procedure	Document Type: Procedure	Page: 2 of 8

Prepared by: Makenzi Mitchell Date: 01/03/2020
Author

Reviewed by: _____ Date: 28 Jan 2020.
Project Sponsor

Approved by: _____ Date: Jan 14/2020
Project Approval Authority Finance

Approved by: _____ Date: 3-Feb-20
Project Approval Authority

**ATTACH BCS

_____ 1/15/2020
Barbara Kerr, VP Controllership

ONTARIO POWER GENERATION

Records File Information:
For all projects, file in accordance with local project management governance
For capital projects, send a copy to Shared Financial Services/Asset Accounting
For PIRs, refer to OPG-PROC-0056; Retention: P

Internal Use Only

FIN-FORM-PA-005-R005*

Project Closure Report

This Project Closure Report (PCR) form is used for documenting relevant project closure information and approving the project closure decision in accordance with FIN-PROC-0030. It may also be used as a Post Implementation Review (PIR) report in accordance with OPG-PROC-0056, Post Implementation Review.

Part 1: Project Account Closure – Complete for all projects	
Is this PCR also used as a PIR report? Yes	**Records Document Number** (required only when the PCR is also used as a PIR report) P-PIR-10000-00001
Project Executing Organization P-PIR-10000-00001Projects and Modifications	**Date** July 5th, 2019
Project Number 13-40983 (Capital)	**Site / Location Name** PNGS
Project Title PB Machine Guarding Improvement on Low Risk Equipment	
Project and Asset (if any) Description PB Machine Guarding Improvement on Low Risk Equipment	
Company Code / Business Area (Controller) 9820	**Asset Class (Controller)** 15400000
Super Asset Number (Controller) 0014601	**Super Asset Description (Controller)** PNGS

Part 2: Final In-Service Transfer – Complete for CAPITAL projects
Final In-Service Transfer Credit Account (Controller)

Part 3: Project Cost and Schedule Variance – Complete for all projects				
	(1) Original Approved Estimate	**(2) Current Approved Estimate**	**(3) Final / Actuals**	**(4) Variance (= 3 – 2)**
Cost ($K)	$5,700	$5,700	$5,169	($531)k
Schedule (In-service date)	2016-12-30	2018-08-30	2018-11-15	10 weeks behind schedule
Deliverables (Completed? Intended Functionality Achieved? Target vs. Actual?)				

*Associated with FIN-PROC-0030, Property, Plant and Equipment

ONTARIO POWER GENERATION

Records File Information:
For all projects, file in accordance with local project management governance
For capital projects, send a copy to Shared Financial Services/Asset Accounting
For PIRs, refer to OPG-PROC-0056; Retention: P

Internal Use Only
FIN-FORM-PA-005-R005

Project Closure Report

Project Number: 13-40983 (Capital)			
Project Title: PB Machine Guarding Improvement on Low Risk Equipment (Capital)			
	Approved LTD	**Actual LTD**	**Variance (Actual-Approved)**
OPG Projects	$1126k	$1,340k	$214k
OPG Engineering	$302k	$301k	($1k)
Design Contract	$974k	$795k	($179k)
Procured Materials	$46k	$17k	($29k)
OPG Construction	$369k	$409k	$40k
Construction Contract	$2024k	$2,111k	$87k
Interest	$219k	$196k	($23k)
Contingency	$640k		($640k)
Total	**$5700k**	**$5169k**	**($531k)**

The OM&A portion of the project has already been closed out. This closeout report is only for the Capital portion of the project.

From the BCS, the total budget approved for the Capital portion of the project was $5,700k. However, only $5,169k of the total amount was spent on this project. This resulted in the project being under budget by $531k. It was a combination of improved efficiencies and lower contractor costs. Analyzing the pivot table for the capital portion of the project, OPG underspent in Construction Contract, Design Contract, OPG Engineering and Interest, which led to the project being under budget by $531k.

There was re-work which had to be done on a total of 6 guards in U1 and U4 Boiler Feed Pumps to address vibration monitoring issues raised by the Component Engineering department. As this issue should have been identified by the vendor during the design phase, this resulted in delays to the schedule. The vendor absorbed the cost of re-work. Additionally, due to the station equipment unavailability, the Boiler Feed Pump guards could not be installed as scheduled. As a result, the AFS was pushed by 10 weeks to November 15, 2018.

Project Milestone	Baseline	Current	Variance (Baseline - Current,Days)
Detail Design Complete by OPG I&C	30-Dec-15	19-Mar-15	286
B&M – Machine Guards Detailed Design by Contractor	01-Oct-18	01-Oct-18	0
B&M Fabricate Guards – Installation Contract	23-Dec-15	30-Dec-15	(7)
SBCS B&M/RCM – Procure Materials, Fabricate Guards	28-Dec-16	28-Dec-16	0
B&M Install Guards Installation Contract	30-Dec-15	26-Feb-16	(58)
AFS Work Group 1 Machine Guards	05-Nov-15	14-Oct-16	(344)
AFS Work Group 2 Machine Guards	29-Oct-15	30-Mar-15	213
AFS Work Group 3 Machine Guards	29-Oct-15	21-Apr-15	191
AFS Work Group 4 Machine Guards	29-Oct-15	21-Apr-15	191
Document Close-Out Group 1	22-Apr-16	15-Mar-17	(327)
Document Close-Out Group 2	02-May-16	01-Sep-15	244
Document Close-Out Group 4	02-May-16	21-Oct-15	194
Project Closeout Completed (Including new scope)	31-May-19	29-Mar-2019	63
SBCS – All ECs Closeout Completed	31-May-19	29-Mar-2019	63
Project Complete Milestone	30-Aug-19	14-Jun-19	77

*Associated with FIN-PROC-0030, Property, Plant and Equipment

Project Business Case Summaries (BCSs)			
Type of Release	Project Cost (Including contingency) & Schedule	Deliverables of Release	Approval
NK30-BCS-10000-00003 Full Release for Execution	Approved Project Estimate: $10,459k (Capital + OM&A). Schedule Target Project AFS: 2016-12-30	-Complete Detailed Design and Installation for IOP work. -Start of Installation (SOI) -Complete Detailed Design and Installation for Outage work. -Project Closeout (PCR)	Date : Nov 19, 2012 By: Wayne Robbins, CNO
Type of Release	Project Cost (Including contingency) & Schedule	Deliverables of Release	Approval
P-BCS-10000-00002-R000 Full Release for Execution Superseding BCS	Approved Project Estimate: $10,094k (Capital + OM&A). Schedule Target Project AFS: 2018-08-30	-Design Complete (ECP) -Start of Installation (SOI) -Available for Service (AFS) -Project Closeout (PCR)	Date : Sep 14, 2016 By: Sunantha Broekhuyse, Project Manager

Project Change Request Authorization Forms (PCRAFs)		
Change Request	Description of Variance	Date of Approval
PCRAF002 on Exec Full Release BCS	Due to efficiencies and lower contractor costs, the project was underspent in 2015. Cash flow for 2015 adjusted to reflect savings. Current cash flows do not include additional scope.	Dec 16, 2015
PCRAF003 on Exec Superseding BCS	Have aligned cost to December forecast (509k), which adjusted cash flow to address late approval of BCS. Total budget, project schedule and commitments achieved as per the BCS.	Feb 22, 2017

Change Control Forms (CCFs)		
Change Request	Description of Variance	Date of Approval
PMCCF-002335 to ask for Contingency.	The cost change for the release of $124.6k in contingency was requested. This was due to the fact that some re-work had to be done on the guards for the Boiler Feed Pumps to address the vibration monitoring issues. Actions were taken to get the vendor to absorb the charges for the re-work of the guards, however, the delay in schedule caused the project to go over the original budget. Additionally, there were some delays caused by station condition which also contributed to the increase in cost.	15 Nov, 2018

Project Closure Report

References or attached pages for:

- Listing in chronological order of all corresponding BCSs and of variance approvals – date and approval authority; and what approved – cost, schedule, and deliverables
- Reference the "lessons learned report"
- Discussion and analysis – cost, schedule, deliverables, and key lessons learned

*Associated with FIN-PROC-0030, Property, Plant and Equipment

Lessons Learned from this project are summarized below:

1. The Design Contractor had enough information from OPG to build and install the Machine Guards For Boiler Feed Pumps (Tag #s 1,4-43230-P6, P7, P8). They did not however exercise sufficient due diligence to question various technical aspects which finally forced them to re-design these guards.

2. The Plant Maintenance personnel did not make clear what functional/design features they wanted from the above guards. Vibration monitoring group should have been included amongst the key stakeholders to this project but they were not, hence the design was not circulated to them in due course.

3. The COMS process was not adequate at the time of Scope Definition. In the end, the cost of installing permanent Vibration Monitors was unacceptably high for OPG and the guards had to be re-designed to allow for the use of less expensive Hand Held devices for such measurements.

4. The collaborative function of the Projects Design personnel with Plant Maintenance and the Design Contractor was also less than ideal particularly with respect to the cost estimate of the Permanent Vibration Monitors. This situation was discovered too late, when the initial design was ready for AFS.

5. This project had more than its fair share of FIC Requests and Minor FICs. To some extent they can be related to less than adequate COMS, Walk-downs and evolving design. (Fortunately each Machine Guard is in itself a mini-project which impacted the overall scope in a limited way.)

6. Bill of Materials (BOM) should be more detailed to avoid confusion of tools/materials between the procurement team and trades.

7. <u>On the positive side:</u> There were many things that went well in this project. There were over 50 equipment under this modification that were guarded without any issues, and we were able to meet the tight deadlines and execute the work safely. All ARs were completed ahead of schedule during the closeout phase.

8. Project was completed on budget and with quality. Project cost was adequately monitored and controlled

9. Trades executed the work with quality and followed all instructions/hold points presented in the ITPs.

10. Adequate FME planning and execution while drilling and collecting debris.

The following SCRs were generated for this project:

SCR	Description
P-2017-14096	Crew on delay. no work can be pulled ahead due to schedule constraints
P-2017-14097	Work can't be completed on 0-71330-PM501 due to plant condition; equipment was shutdown and now it's running. Measured task missed. Crew was redirected to work on 0-71330-PM502 instead which was scheduled for next week.
P-2017-14785	Work can't be completed on 4-43230-P6 as scheduled due to maintenance for this equipment has been cancelled; equipment is now running. Measured task missed.
P-2017-14882	Work on equipment 0-71330-PM501 delayed due to duty swap not being completed as planned
P-2017-14883	Work can't be completed on 4-43230-P6 as scheduled due to maintenance for this equipment has been cancelled; equipment is now running. Delay to crew Millwrights GF 6 hours, 2x Millwrights JRM 8 hours, QC inspector 4 hours, and QC supervisor 1 hour, Project Coordinator 2 hours, Project Manager 2 hours
P-2017-15085	Delay due to 018-34230-FM102 requires a ROM slip and 012-75130-CMP2 permit is not ready as planned.
P-2017-15460	Delay due to 018-34230-FM102 ROMS slip not ready QC inspector 4 hours, and QC supervisor 1 hour, Project Coordinator 2 hours, Project Manager 2 hours
P-2017-15607	HOR and HOR supervisor missed delay hours from the following SCR's: P-2017-14097(JUN-14); HOR 8 hours & HOR SV 8 hours, P-2017-14882(JUN-19); HOR SV 8.5 hours, P-2017-14883(JUN-23); HOR 8hours & HOR SV 4 hours, P-2017-15460(JUN-29) HOR 4 hours & HOR SV 4 hours. ROONEYT 2017/07/05 10:51 : SCR initiated to capture delay costs the were mistakenly left off of previous SCR's, no further action required.

*Associated with FIN-PROC-0030, Property, Plant and Equipment

N-2017-22079	Delay for guard installations on 1-71210-PM1. Upper bearing keep was not removed for crew to start working on guard installations. Delay for 2 workers, HOR and QC x 8 hours, 1 PM and 1 PC x 2 hours and supervision x 4 hours.
P-2017-21461	Permitry delay due to system still draining. WO 5132915-04. Delays, 2 millwrights, 1 HOR x 8 hours, GF x 4 hours, PM/PC x 2 hours.
N-2018-16110	Op's unable to swap permits from Boiler Feed Pump 6 to BFP 7 due to a dropped relay, which was documented in SCR 2018-15753. This has caused a delay to the installation of a machine guard that was scheduled for WW29. Delays incurred to Black and McDonald are as follows; 2 Millwrights x 8 hours, 1 Millwright GF x 2 hours, 1 HOR x 8 hours and 1 QC x 2 hours.

Part 4: PCR Approval Signatures – Complete for all projects

Project Manager: The project is declared closed. I confirm that all remaining materials (if applicable) of the project are appropriately dispositioned as spare parts to accepting business areas or are declared surplus. No costs shall be charged to this project at this point forward.

Controller for Project Organization (if applicable, i.e., the BU/Function has a Project Organization Controller): I confirm the information documented in this PCR is correct.

PCR Submitted by: Project Manager	**PCR Reviewed by: Controller for Project Executing Organization** (if applicable)
Rajkumar Ramaswamy Section Manager, Pickering Projects Projects and Modifications 21-JUNE-19 **Date**	Approved Electronically Shawn Klis Finance Controller, P&M **Date**

Station / Plant Group / Function Controller: I confirm the information documented in this PCR is correct.

Asset Owner: I authorize the decision to declare project closure for this project.

PCR Reviewed by: Controller for Sponsoring Organization	**PCR Approved by: Asset Owner or Sponsoring Organization Authority**
Approved Electronically Melissa Hannon Finance Controller, PNGS **Date**	Approved Electronically Richard Geofroy Director Ops & Mtce, PNGS **Date**

Part 5: PIR Signature – Required only when the PCR is also used as a PIR report

	Signature	**Date**
I have reviewed and accept the PIR results in this report.		
Reviewed by: Project Sponsor Richard Geofroy - DOM PNGS Name Title, Department, BU/Function	Approved Electronically	

Part 6: Distribution – Required only when the PCR is also used as a PIR report

Distribution:

When this PCR is also used as a PIR report, the Project Sponsor shall ensure distribution (cc) to the following personnel if they have not already signed off above:

- Finance Approver in the BCS: Name, Title, Department, BU/Function
- Line Approver in the BCS: Name, Title, Department, BU/Function
- Other key stakeholders:
  Name, Title, Department, BU/Function

Project Closure Report

Part 7: PCR Checklist – Complete for all projects by Project CSA or Project Manager	
Checklist Item	**Checkbox**
All Tempus Work Events have been closed, including: • Assigned Tempus Work Events • AS7 Work Order Task created work events	 ☒ ☒
All PO/WO/MRs/CRs have been closed, including: • Request sent to AS7 buyer to close PO/COs after closing related MRs/CRs • Request sent to Planner to close any AS7 Work Order Tasks • Request sent to ONCORE to close all tasks and associated PO's	 ☒ ☒ ☒
All Accruals have been cleared.	☒
Any purchases through purchasing cards (VISA) or Ariba Web Catalogue have been reconciled in Concur or shipped by Ariba Vendor.	☐
All default Business Expense or VISA default accounts have been changed.	☐
All spare parts have been set up in AS7, including: • Inventory by Cat ID with ROP/TMAX values • Capital Spares are set up in the appropriate Asset Class and account	 ☒ ☒
All obsolete or surplus inventory or components have been identified and Surplus Declarations routed to ensure that all retired assets have been properly removed from the fixed asset ledger and inventory accounts.	☐
The Super Asset Class, the Company Code, Super Asset Numbers agree with previous REIS.	☐
The Final Actual Costs and Current Approved Estimate agree with FRA and/or SAP.	☒
If this is combined PCR/PIR, it was defined in the approved BCS.	☐
If the Actuals are greater than the Approved amount, the overspend has been approved in accordance with the appropriate OAR Element specified in the BCS standard (OPG-STD-0076, Developing and Documenting Business Cases), with an approved OPG-FORM-0077, Project Over-Variance Approval or a Superseding BCS.	☒
A copy of the FRA and/or SAP Report is attached.	☒

Project CSA / Project Manager (Sign-Off): I confirmed the completion of all the checklist items.		
Project CSA or Project Manager Name Title, Department, BU/Function	**Signature** Shishir Dhakal Ion Secareanu	**Date** 21-Jun-2019 21-Jun-2019

ONTARIO POWER GENERATION	Document Number: FIN-TMP-PA-002*	Revision: R02	Page: 1 of 2
	POST IMPLEMENTATION REVIEW TEMPLATE (For Simplified PIRs only)		

Station:	Project Name:	Project No.:	Units:	Controlled Doc No.:
PNGS	Pickering A ECI Strainer Capacity Margin Improvement	13-40984	1, 4	NA44-PIR-33350-00001 R000

Approval	Cost	Date
Original Approval Estimate	$9 287 K	25Jan2010
Approval Revision Estimate	$9 364 K	10Dec2010
Final Approval Estimate	$9 364 K	N/A
Final Actual Project Cost	$7364K	30Apr2014

Timing	
Target Date	01Nov2013
Latest Approved i/s Date	31Dec2013
In Service Date	U1: 18Dec2012 U4: 15May2013
Period used to calculate Performance result	"In Service Date" to 30Apr2014

DELIVERABLES

Target	Achievement
Increased strainer capacity margin	Design requirements were met, as demonstrated by stakeholder acceptance and AFS signoff. AFS documents are as follows: • NA44-REP-33350-00022 for 1-34310-STR2 • NA44-REP-33350-00023 for 1-34310-STR3 • NA44-REP-33350-00025 for 4-34310-STR2 and 4-34310-STR3
Modifications as per TOE (NA44-33350-00002) evaluation results	There were four corrective actions associated with the TOE, all of which are complete: • AR 28134500-05 for analysis of unmodified portion of strainers, and impact on thermal expansion (03Apr2013). • AR 28134500-06 for revision of project charter (03Apr2013). • AR 28134500-07 for expansion of scope, and development of outage plan for P1211 (03Apr2013). • AR 28134500-08 for expansion of scope, and development of outage plan for P1341 (21May2013). Completion confirmed by Reactor Safety per BCS.

QUALITATIVE RESULTS

Strainer Performance	The newly installed ECI strainer modules have demonstrated that their hydraulic performance have improved by increasing the strainer capacity margin. After the modification, the probability of a forced outage due to insufficient margin has been lowered from 30% to 1% per Project Closure Report.

KEY LESSONS	
Contingency Planning during the Design Phase	Incorporate flexibility into execution plans and design ECs in order to mitigate risks.
U1 Anchor Design	Due to the nature of the ECI strainers, they are not easily accessible for visual inspections.There were design and installation challenges because of this, as walkdowns could not be performed to mitigate these discrepancies. When preparing designs for components/systems, if key elements cannot be observed through walkdowns, flexibility should be built into the design product. When the area is accessible, walkdowns are important to inspect the field configuration.
Vendor Quality	Per Section 3.3 of NA44-LLD-33350-00001: • Manufacturer's lack of control over suppliers and sub-suppliers • Communication between all three groups are critical to success and high quality products
FOLLOW-UP ACTIONS	
OPG oversight to ensure high quality products from manufacturers	• OPG Corrective Actions Initiated: NCAR 28150478-47 initiated to CANDU in Feb2013 • In July 2013, Supply Chain Quality Services received and accepted the action to minimize recurrence. • CANDU corrective actions as a result of NCAR (presented to OPG in April 2014): Ensure on-site walkdowns performed when permissible; when walkdown not possible, assess and mitigate risk alongside client (process captured in new procedure); CANDU Engineering Projects Management to be informed of risks related to execution of an order.

Prepared by: Raeshel Garcia Date: 27NOV2014
Raeshel Garcia – ECI System Engineer

Reviewed by: Date Dec 7 2014
Dean Townsend – Project Sponsor

Approved by: Date: Dec 10/14
Carla Carmichael – VP, Nuclear Finance

Approved by: Date: 11 Dec 2014
Brian McGee – Site Vice President

ONTARIO POWER GENERATION	Document Number: FIN-TMP-PA-002*	Revision: R02	Page: 1 of 2
	POST IMPLEMENTATION REVIEW TEMPLATE (For Simplified PIRs only)		

Station: Pickering	Project Name: Emergency Power Generator Engine Replacement	Project No.: 13-41043	Units: 058	Controlled Doc No.: NK30-PIR-54800-00004

Approval	Cost	Date
Original Approval Estimate	$19,941k	18-Dec-2014
Approval Revision Estimate	$16,576 k	18-Feb-2016
Final Approval Estimate	$9,668k	05-Oct-2016
Final Actual Project Cost	$6,564k	21-Dec-2017

Timing	
Target Date	30-Jan-2017
Latest Approved i/s Date	30-Jan-2017
In Service Date	25-Nov-2016
Period used to calculate performance result	3.25 years

DELIVERABLES	
Target	**Achievement**
EPG1 & EPG2 available following engine replacement	EPG1 returned to service 14-Aug-2016, EPG2 returned to service 25-Nov-2016, well ahead of the target date.
EPG system availability 95% or greater	2017 – 99.98%, 2018 – 95.53%, 2019 – 89.84%. The sub-target availability in 2019 is attributed to forced unavailability of EPG3, as well as a planned major outage on both EPG2 and EPG3. EPG1 had 99.66% availability, and EPG2 had 99.08% availability with the planned major outage excluded.
Engine spare parts required for station station end of life are available	Adequate lifetime spare parts were procured and are in stock to support EPG availability to end of station life. Reference AFS reports NK30-REP-54800-00088 (EPG1) and NK30-REP-54800-00092 (EPG2) for spare parts CIDs.

QUALITATIVE RESULTS	
N/A	

KEY LESSONS	
NK30-REP-54800-00088	EPG1 Engine Replacement AFS Report
NK30-REP-54800-00092	AFS Report Pickering EPG2 Engine Replacement
FOLLOW-UP ACTIONS	
N/A	

Prepared by: _____
Zac Siegel
Assistant Technical Officer,
Performance Engineering

Date:_____

Reviewed by: _____
Mitch Hines
Manager,
Performance Engineering

Date:_____

Approved by: _____
Melissa Hannon
Finance Controller,
Pickering NGS

Date:_____

Full Release BCS:

P-BCS-54800-00005
R002 SIGNED - 06Oc

ONTARIO POWER GENERATION

Records File Information:
For all projects, file in accordance with local project management governance
For capital projects, send a copy to Shared Financial Services/Asset Accounting
For PIRs, refer to OPG-PROC-0056; Retention: P

Internal Use Only

FIN-FORM-PA-005-R005*

Project Closure Report

This Project Closure Report (PCR) form is used for documenting relevant project closure information and approving the project closure decision in accordance with FIN-PROC-0030. It may also be used as a Post Implementation Review (PIR) report in accordance with OPG-PROC-0056, Post Implementation Review.

Part 1: Project Account Closure – Complete for all projects	
Is this PCR also used as a PIR report? No	**Records Document Number** (required only when the PCR is also used as a PIR report) N/A
Project Executing Organization Design Projects	**Date** August 25, 2017
Project Number 13-46605	**Site / Location Name** Pickering
Project Title 13-46605 PA Passive Autocatalytic Recombiners	
Project and Asset (if any) Description Pickering Passive Autocatalytic Recombiners	
Company Code / Business Area (Controller) 9820	**Asset Class (Controller)** 15340000
Super Asset Number (Controller) 00149	**Super Asset Description (Controller)** Pickering GS - Common Services

Part 2: Final In-Service Transfer – Complete for CAPITAL projects
Final In-Service Transfer Credit Account (Controller) 12,156

Part 3: Project Cost and Schedule Variance – Complete for all projects

	(1) Original Approved Estimate	(2) Current Approved Estimate	(3) Final / Actuals	(4) Variance (= 3 – 2)
Cost ($K)	12,923	14,372	12,094	-1,938
Schedule (In-service date)	2012-02-29	2012-02-29	2014-05-02	113 weeks behind schedule

Deliverables (Completed? Intended Functionality Achieved? Target vs. Actual?)

Refer to Project Deliverables Report below

References or attached pages for:

- Listing in chronological order of all corresponding BCSs and of variance approvals – date and approval authority; and what approved – cost, schedule, and deliverables
- Reference the "lessons learned report"
- Discussion and analysis – cost, schedule, deliverables, and key lessons learned

*Associated with FIN-PROC-0030, Property, Plant and Equipment

Part 4: PCR Approval Signatures – Complete for all projects	
Project Manager: The project is declared closed. I confirm that all remaining materials (if applicable) of the project are appropriately dispositioned as spare parts to accepting business areas or are declared surplus. No costs shall be charged to this project at this point forward. **Controller for Project Organization (if applicable, i.e., the BU/Function has a Project Organization Controller):** I confirm the information documented in this PCR is correct.	
PCR Submitted by: Project Manager Electronically Approved See Attachment for Approvals Cleve DeSouza Project Manager, Projects and Modifications **Date**	**PCR Reviewed by: Controller for Project Executing Organization** (if applicable) Electronically Approved See Attachment for Approvals Shawn Klis Finance Controller, P&M **Date**
Station / Plant Group / Function Controller: I confirm the information documented in this PCR is correct. **Asset Owner:** I authorize the decision to declare project closure for this project.	
PCR Reviewed by: Controller for Sponsoring Organization Electronically Approved See Attachment for Approvals Barb Kerr Finance Controller, PN **Date**	**PCR Approved by: Asset Owner or Sponsoring Org** Electronically Approved See Attachment for Approvals Jason Wight Director, Station Engineering PN **Date**

Part 5: PIR Signature – Required only when the PCR is also used as a PIR report		
	Signature	**Date**
I have reviewed and accept the PIR results in this report.		
Reviewed by: Project Sponsor Name Title, Department, BU/Function	N/A	

Part 6: Distribution – Required only when the PCR is also used as a PIR report
Distribution: When this PCR is also used as a PIR report, the Project Sponsor shall ensure distribution (cc) to the following personnel if they have not already signed off above: • Finance Approver in the BCS: Name, Title, Department, BU/Function • Line Approver in the BCS: Name, Title, Department, BU/Function • Other key stakeholders: Name, Title, Department, BU/Function

*Associated with FIN-PROC-0030, Property, Plant and Equipment

Part 7: PCR Checklist – Complete for all projects by Project CSA or Project Manager	
Checklist Item	**Checkbox**
All Tempus Work Events have been closed, including: • Assigned Tempus Work Events • AS7 Work Order Task created work events	 ☒ ☒
All PO/WO/MRs/CRs have been closed, including: • Request sent to AS7 buyer to close PO/COs after closing related MRs/CRs Refer to Appendix D • Request sent to Planner to close any AS7 Work Order Tasks • Request sent to ONCORE to close all tasks and associated PO's	 ☒ ☒ ☒
All Accruals have been cleared.	☒
Any purchases through purchasing cards (VISA) or Ariba Web Catalogue have been reconciled in Concur or shipped by Ariba Vendor. N/A	☐
All default Business Expense or VISA default accounts have been changed. N/A	☐
All spare parts have been set up in AS7, including: • Inventory by Cat ID with ROP/TMAX values • Capital Spares are set up in the appropriate Asset Class and account	 ☒ ☒
All obsolete or surplus inventory or components have been identified and Surplus Declarations routed to ensure that all retired assets have been properly removed from the fixed asset ledger and inventory accounts. N/A	☐
The Super Asset Class, the Company Code, Super Asset Numbers agree with previous REIS.	☒
The Final Actual Costs and Current Approved Estimate agree with FRA and/or SAP.	☒
If this is combined PCR/PIR, it was defined in the approved BCS.	☒
If the Actuals are greater than the Approved amount, the overspend has been approved in accordance with the appropriate OAR Element specified in the BCS standard (OPG-STD-0076, Developing and Documenting Business Cases), with an approved OPG-FORM-0077, Project Over-Variance Approval or a Superseding BCS. N/A	☒
A copy of the FRA and/or SAP Report is attached. Refer to Appendix A	☒

Project CSA / Project Manager (Sign-Off): I confirmed the completion of all the checklist items.		
Project CSA or Project Manager Shawn Reilly CSA, Projects and Modifications	**Signature** Electronically Approved See Attachment for Approvals	**Date**

Project Deliverables Report

1.1 Problem Statement

Hydrogen can be introduced into the atmosphere following a Design Basis Accident (DBA) such as Loss of Coolant Accident (LOCA) or with Loss of Emergency Coolant Injection (LOECI). To address these concerns, hydrogen igniters were installed in each of the Pickering Units (12 in Unit A and 15 in Unit B) to ignite mixtures near the flammability limits in a post-accident environment. As a backup to the hydrogen igniters (short term hydrogen mitigating system), Passive Auto-catalytic Recombiners (PAR's) were installed as the support for long term hydrogen mitigation.

1.2 Project Objectives

To implement Passive Auto-Catalytic Recombiners across all operating units at Pickering A and B in response to lessons learned from Japanese Fukushima nuclear events and commitments being made to the CNSC.

2.0 Deliverables and Milestones (Target vs. Actual)

2.1 Deliverables

Target	Actual
○ Complete Installation of PAR's in the following units: ○ Installation of 20 PAR's in Unit 1 ○ Installation of 20 PAR's in Unit 4 ○ Installation of 30 PAR's in Unit 5 ○ Installation of 30 PAR's in Unit 6 ○ Installation of 30 PAR's in Unit 7 ○ Installation of 30 PAR's in Unit 8 ○ Installation of the PAR's maintenance facility	○ Project 13-46605, MEC 107456 was completed with the following dates: ○ All PAR's for Unit-1 were Installed and Available For Service on December 18, 2012 ○ All PAR's for Unit-4 were Installed and Available For Service on November 30, 2011 ○ All PAR's for Unit-5 were Installed and Available For Service on May 29, 2013 ○ All PAR's for Unit-6 were Installed and Available For Service on December 11, 2013 ○ All PAR's for Unit-7 were Installed and Available For Service on November 27, 2012 ○ All PAR's for Unit-8 were Installed and Available For Service on May 31, 2014 ○ All PAR's for the maintenance facility were installed and Available for Service on March 27, 2012

2.2 Milestones Compliance Summary

Scope	Planned	Actual
Detailed Engineering design completed (Unit 8)	February 21, 2013	February 14, 2013
Unit 4 PARs SOI	September 20, 2011	September 21, 2011
Unit 8 PARs SOI	February 14, 2014	January 17, 2014
Unit 8 PAR's AFS	April 30, 2014	May 02, 2014
Project complete milestone	April 15, 2015	xxxxxx

3.0 Approval History

3.1 Funding History

Type of release	Released Amount (K$)	Cumulative Total (K$)	Scope of release	Approval date	Approval Authority
Partial release	1,167	1,167	○ Complete preliminary engineering phase -. ○ Procuring long lead material	January 13, 2010	Jamie Lawrie and Robert Black
Full release	3,872	5,039	○ Complete detailed engineering design, Assessment, Execution and closeout.	October 21, 2010	Randy Leavitt and Glenn Jager
Superseding	4,756	8,571 (after 1,224 adjustment)	○ Fund completion of all detailed engineering. ○ To award a contract to procure Passive Auto-Catalytic Recombiners (PARs) for the project.	June 24, 2011	Randy Leavitt and Wayne Robbins
Full release	6,091	14,372 (after 290 adjustment)	○ To fund detailed engineering, modification, commissioning and closeout for all units.	February 29, 2012	Randy Leavitt and Wayne Robbins

3.2 Change History

PCRAF #	Description of change	Approval date
46605-001	Change in cash flow to cover delay in material delivery and to cover change in PAR's location and design documentation.	November 11, 2011
46605-002	Change in cash flow to cover construction costs of contractor.	August 02, 2012
46605-003	Change in cash flow to cover execution costs due to outage delays. Note: Shows 003 in PPM but on document shows #1. Should be #3.	December 11, 2013

46605-004	Change in cash flow due to discrepancies in materials causing higher than anticipated spending.	January 21, 2014
46605-005	Change in cash flow due to delays driven by higher priority outage work and costs associated with closeout activities	May 14, 2014
46605-006	Change in cash flow to align AISC approved cash flow with the current 2014 forecast.	November 13, 2014

4.0 Cost and Schedule

4.1 Cost

Under the Full Release BCS (P-BCS-34330-00003) the life to date approved funding of 6,091K was used to complete modifications in each operating Pickering unit and for closeout activites.

Table 1 below, illustrates the cost variance through the life of the project. Positive variances indicate costs that were under budget and negative variances indicate costs that were over budget. Comparing the project allotted budget ($12,923K) vs. the project actual completion cost ($12,053K) produces a positive variance of $ 830K. This indicates that the project was completed under the assigned budget.

Negative variances were recorded on only two resource types. Project Management costs were $657K over budget due to the extension of the planned PARs execution durations, delays for awarding material contracts, costs due to outage priority. Similarly, OPG engineering costs went over budget by 97K due to maintenance facility location changes and post installation close out activities. The negative variances were offset primarily by positive variances in Materials, Design, construction and close out costs. Overall, the actual cost is less than the assigned budget. Detailed breakdown of the cost variances is summarized as follows:-

Resource type	Actual (k$) (As of AUG,2017)	Budget (k$)	Variance (K$)	Notes
Project Management	2,722	2,065	-657	Extension of the planned PARs execution durations. Outage priority delays
Engineering – OPG	1,082	985	-97	Project close out activities
Materials	3,593	4,256	663	
Design, Construction and closeout	4,318	4,986	668	
Interest	378	631	253	
Total	**12,053**	**12,923**	**830**	

Table 1: 13-46605 Project Variance Breakdown

4.2 Schedule

As per the latest PCRAF, All key milestones have been completed by May 2014, as planned. All Items relating to installing Passive Autocatalytic Recombiners (PARs) in all Pickering units, as well as a PARs Maintenance Facility were complete under Admin Building Project 13-46605.

The project was fully closed in June 2014.

4.3 LESSONS LEARNED REPORT

See the following Document #'s:

UNITS	Document Numbers
U4 and Maintenance Facility	NA44-LLD-34330-00001
U1 & U7	NA44-LLD-34330-00002
U5 ,U6 & U8	NK30-LLD-34330-00001

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Station: PNGSB	Project Name: PB SG/EPG Fire Detection Upgrade and CO2 Removal	Project No.: 13-49116	Units: 058	Controlled Doc No.: NK30-PIR-71400-0808620

Approval	Cost	Date
Original Approval Estimate	$4,100k	17Feb2010
Approval Revision Estimate	$10,741k	29Nov2012
Final Approval Estimate	$10.741k	29Nov2012
Final Actual Project Cost	$8,169k	24Mar2016

Timing	
Target Date	16Apr2014
Latest Approved i/s Date	14July2016
In Service Date	24March2016
Period used to calculate Performance result	24Mar2016 to Dec2019

DELIVERABLES	
Target	**Achievement**
The SG, SGOP and EWPS buildings possess a fire code compliant, reliable and maintainable fire detection system to protect the assets they house.	In March 2016, the SG, SGOP and EWPS building possessed a fire code compliant, reliable and maintainable fire detection system to protect the assets they house. These fire systems will provide early fire warning to the Main Control Room and Emergency Response Team, so that fire incidents in these buildings can be addressed promptly.

QUALITATIVE RESULTS	
Fire System and Life Safety Code Compliance.	Fire Hazard Assessment and Code Compliance Review completed in 2017 recorded no code deviations in the areas upgraded by project 13-49116.
Reliability of fire detection systems in SG/SGOP/EPG buildings.	Since March 2016 there have been 3 recorded functional failures. 1 each on the following fire detection systems: 056-SG3, 056-SG2 and 078-SG2.

KEY LESSONS	
Load Verifications	The work required to complete load verifications was found to be very complex and required more time than originally anticipated. In addition, maintenance could not support load verifications as per the project schedule. This resulted in delays of approximate 7-8 weeks for both the 056 and 078 SGs. It is recommended that load verification activities be scheduled months in advance of the target start of the installation date to ensure that it is completed in time for permitry preparation.

FOLLOW-UP ACTIONS	
N/A	N/A

Prepared by: _____ Date: 30 Dec 2019
Jon Bruce
System Engineer, Pickering Performance Engineering
Author

Reviewed by: _____ Date: 8-JAN-2020
Jason Wight
Director Station Engineering
Project Sponsor

Approved by: _____ Date: Jan 14/2020
Melissa Hannon
Finance Controller
Project Approval Authority Finance

Approved by: _____ Date: 24 JAN 2020
Richard Geofroy
Director Operations & Maintenance
Project Approval Authority

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_____ JAN 15, 2020
Barbara Kerr
VP Controllership

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Station:	Project Name:	ProjectNo.:	Units:	Controlled Doc No.:
Pickering	PB RBSW De-chlorination and MISA clean up	49132	058	NA44-PIR-71750-0805463

Approval	Cost	Date
Original Approval Estimate($K)	7,268	2012-12-10
Approval Revision Estimate($K)	15,148	2017-07-17
Final Approval Estimate	15,148	2017-07-17
Final Actual Project Cost($K)	14,776	2017-08-31

Timing	
Target Date	2018-03-30
Latest Approved i/s Date	2016-11-14
In Service Date	2018-01-31
Period used to calculate Performance result	2018-01-31 To 2019-10-12

DELIVERABLES	
Target	**Achievement**
Complete Demolition of old de-chlorination system	Environment trailer housing Liquid Effluent gross Beta and Gamma samplers along with 4 SMB tanks removed successfully in line with NK30-WPL-71750-04534.
Install RBSW De-chlorination and LEM system	Winterized SMB tank and piping were installed along with SMB injection pumps and total residual chlorine analyzers, this enables control of how much chlorine the station discharges to the lake. Fire detection systems were also installed in the permanent buildings.

QUALITATIVE RESULTS	
De-chlorination System Performance	Previous baseline was lack of redundancy and equipment reliability. After project completion, system is now winterized and has proper ventilation, this prevents SMB from freezing in tanks during winter time and makes tanks more reliable. Multiple SMB injection pumps, TRC analyzers and sampling equipment were also installed to ensure redundancy.

KEY LESSONS	
Inadequate Room for system equipment	Prior to determining system layout, design engineering completed design for new building, during execution it was discovered that the space was inadequate, this has made it difficult for station resources to maintain the system. Issue should have been discussed prior during Detailed Design Constructability, Operability, Maintainability and Safety (COMS) process.
System Clogging due to Debris	Original pumps installed to provide flow to the LEM system's gross gamma/beta samplers were not powerful enough to compensate for the debris and zebra mussels. These pumps became clogged and had to be replaced with larger pumps through an additional round of installation and commissioning.
Reference	NK30-LLD-71650-00001, PB RBSW De-chlorination and LEM System-Lessons Learned Report.

FOLLOW-UP ACTIONS	
	No Follow up actions required

Prepared by: _____ Date: 10 DEC 2019
Ekpeju Ogbemi
University Student, Pickering Performance Engineering
Author

Reviewed by: _____ Date: 8- JAN 2020
Jason Wight
Director Station Engineering
Project Sponsor

Approved by: Melissa Hannon Date: Jan 14/2020
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Station:	Project Name:	Project No.:	Units:	Controlled Doc No.:
Pickering	High Activity Containment Box Up Monitor Replacement Project	13-49134 (EC 111888, 111930)	5, 6, 7, 8 & VB	NK30-PIR-63420-00001

Approval	Cost	Date
Original Approval Estimate	$7,897k	20Dec2010
Approval Revision Estimate	$8,123k	13Nov2012
Final Approval Estimate	$8,830k	30Jan2014
Final Actual Project Cost	$6,992k	$6,942k as of 18Jan2016 +$50k budgeted for close outs in 2016

Timing	
Target Date	31Jul2015
Latest Approved i/s Date	31Jul2015
In Service Date	8May2015
Period used to calculate Performance result	First Unit: 10Oct2013 (U5 Ch P) Last Unit: 17Apr2015 (U6 Ch P)

DELIVERABLES

Target	Achievement
Expected zero failure rate to meet Target unavailability of Negative Pressure Containment system $1.0X10^{-3}$ y/y due to replacement of new High Activity Containment Box Up Monitors.	A review of the RB High Activity Box Up Containment Test (NK30-SRS-C-001) was completed since the BOT Monitoring System was installed on each Unit. There were no failed tests during this time due to Activity Monitor system deficiency. Therefore, the BOT Monitoring system has been successful in boxing up the RB at the required set point of 500cps. A search of the SCR database, however, indicates that a number of spurious box ups are still occurring across PNGS Units 5-8 and the VB. A total of 10 spurious box ups have occurred with the newly installed BOT system, particularly on Unit 6 Ch N which has experienced 5 spurious box ups. The spurious events cause the RB/VB to box up which is considered the "safe state". Upon investigation, no equipment deficiencies have been found except for on the VB where the detector and AGC amplifier were replaced (immediately following commissioning). Following this, no box ups have occurred on the VB. Prior to the BOT installations, the spurious box ups in many instances were due to aging/equipment failure. The recent spurious box ups are not considered to be equipment failures because no equipment failures are discovered upon investigation. These box ups do not contribute to Containment System unavailability since the systems are boxing up at the required set points and passing Containment tests. The BOT system is designed to look for an 8 Volt signal with a tolerance of +/- 2 Volts. If the signal spikes more than the range of 6 to 10 Volts or drops out momentarily, a system error is generated (e.g. detector error and pulsar rate error). When the system sees a spike or a drop out it considers it a "fault" and conservatively reacts to trigger a box up. MGMT AR 28183677-03 has been created to produce a SATPS to investigate these events (particularly on Unit 6 Ch N). The following is a list of SCRs due to spurious box ups on the newly installed BOT Monitoring system: Unit 5 Ch P: P-2015-29010 (10Dec2015) Unit 6 Ch N: P-2015-14383 (21Jun2015); P-2015-14402 (22Jun2015); P-

	2015-16660 (21Jul2015), P-2015-20745 (27Sep2015); P-2015-24075 (19Oct2015) Unit 8 Ch P: P-2014-33005 (27Nov2014); P-215-30189 (30Dec2015) Unit 8 Ch N: P-2015-08845 (17Apr2015) VB Ch P: P-2014-08916 (18Mar2014) Overall, the target for the project has been satisfied since the spurious box ups do not contribute to Containment system unavailability. Also, prior to the project, there were no spares for the Harshaw system due to parts obsolescence. There are currently sufficient spares for the replacement BOT Monitoring system. Lastly, feedback from Maintenance is very positive regarding the BOT system in terms of ease of maintainability with a user friendly design. Suggested improvements could be to install a recorder on the system in order to provide a means for monitoring the signal which would be helpful in diagnosing the spurious box ups. Also, the cabling was not replaced during this project which could also account for the spurious box ups.

QUALITATIVE RESULTS	
No Negative Pressure Containment impairment during execution or operation	No Negative Pressure Containment system impairments were incurred as a result of the project execution or following the project during operation of the new equipment.

KEY LESSONS	
Incorrect installation of the "hairpin" on the check source caused the inability to un-box following testing	While performing commissioning of the new BOT Monitors for Unit 8, it was determined that the "hairpin" used to position the check source was installed incorrectly. This hairpin should be installed into the groove of the drive mechanism and not on the top of the said drive mechanism. This could result in spurious box up or could result in the source rod sticking in the raised position following C-001 testing. This condition would not affect the system's monitoring functionality as this is only to do with the check source which is used during testing only. As a result of this lessons learned, the ITP was marked up for future installations and work requests were initiated to verify the hairpin position on previously installed units. See SCR P-2014-32050 for more details. The following work orders are being used to verify hairpin position on previously installed units: WO 2671765, 2671767, 2671769, 2671767, 2671773, 2671774, and 2671771.
Trip set point change from 400cps to 500cps following installation and commissioning of two channels	The box up set point of 400cps was originally provided by NSS and concurrence received by stakeholders in the COMS meetings. However, when operating and maintenance documentation updates via TPARs were provided to the DOM for authorization, it was questioned why the set point was set at that value. The DOM requested for projects to increase the trip set point from 400cps to 500cps to reduce the chance of spurious box ups. The lesson learned is to request DOM to review and concur to trip set points. The trip set point was changed to 500 cps as documented in NK30-CORR-63420-0481863 following installation and commissioning of Unit 5 Ch N and Ch P. Following the trip set point change, the systems were re-commissioned and final AFS completed.
C-014 PMT completed after unit un-box	NK30-SRS-C-014 test was completed after the unit was un-boxed (for Unit 5 Ch P). The PMT for the Containment dampers should have been completed prior to unit un-box. The Work plan was revised to include the completion of the C-014 prior to un-boxing of the RB
AGC Amplifier was unresponsive due to defective cable connection on detector	On Unit 7 Ch N, the AGC Amplifier was found to be unresponsive after being installed. The burn-in and initial calibration of the equipment did not note any issues. For future installations, function checks were incorporated during the burn-in window to provide additional monitoring for potential equipment issues. It was discovered that the detector was

	not sending a signal due to a defective cable connection. The detector was replaced with a new hot spare with no issues. See SCR P-2014-19162 for more details.
Effective use of pre-installation challenge meetings	Prior to all installations, an event-free challenge meeting was held at approximately T-3 with all affected stakeholders involved (construction, engineering, projects, scheduling, assessing, field engineering, operations, maintenance, reactor safety, system engineering, work control). This formal readiness challenge meeting was instrumental in ensuring that work was indeed READY. Although this resulted in the first installation being delayed by a week due to issues discovered and challenges from the station, these meetings ensured that once work was initiated, any issues encountered were dealt with quickly and communicated effectively. As a result of this execution approach, all installations were completed on or ahead of the communicated 5-day box-up window provided by the station.
Review and Incorporation of Lessons Learned	After each installation, formal lessons learned meetings were held to evaluate the performance of the team and highlight issues encountered and to brainstorm ways to streamline installation. As a result of these meetings, the work plans associated with remaining channels were updated to incorporate lessons learned. This strategy was very successful in streamlining the installation and commissioning process of all subsequent replacements.
FOLLOW-UP ACTIONS	
MGMT AR 28177174-01	IUC (Instrument Uncertainty Calculation) NK30-CALC-63420-00001 updates per DCRs 125492 and 125495 to be completed and accepted by OPG. TCD: 29Feb2016
MGMT AR 28177174-02	Issuance of Final Design Plan post-IUC updates (NK30-DP-63420-00001). TCD: 23Dec2015

Prepared by: A. Forte Date: 22 Jun 2016
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Performance Engineering - Nuclear

Reviewed by: Date: 18 Feb 2016
Derick Redden
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Performance Engineering - Nuclear

Approved by: Date: 6/19/16
Carla Carmichael
Vice President
Nuclear Finance

Approved by: Date: 19 Feb 2016
Brian McGee
Senior Vice President
Pickering Nuclear

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Station: Pickering	Project Name: PB Screenhouse Trash Bar Screen Replacement	Project No.: 13-49140	Units: 058	Controlled Doc No.: NK30-71110-00001

Approval	Cost	Date
Original Approval Estimate	$3,139k	NOV 10 2011
Approval Revision Estimate	$6,452k	APR 11 2014
Final Approval Estimate	$7,650k	MAR 23 2015
Final Actual Project Cost	$7,154k	NOV 30 2016

Timing	
Target Date	MAY 11 2012
Latest Approved i/s Date	JUN 24 2015
In Service Date	JUN 24 2015
Period used to calculate Performance result	17 months

DELIVERABLES

Target	Achievement
Sump Cleaning costs related to trash bar screen failures to be $37.5k/year	**Target Achieved:** There was no sump cleaning required due to trash bar screen failures in the reporting period
Operation and Maintenance burdens to be none due to trash removal screen	**Target Achieved**: No functional failure to trash screens and none reported usage of fire water through SCRs.

QUALITATIVE RESULTS

KEY LESSONS

Clearly identify and communicate design specifications to vendors	Equipment vendor did not fully understand the design requirements, which resulted in motor/gearbox and premature wear on the trash screen. **Lesson:** Cost of the project was significantly increased due to multiple equipment replacements which led to significant delays in project completion.
Additional Lessons Learned are captured in AFS Reports	NK30-REP-71120-00003,-00008,-00009 and -00004

FOLLOW-UP ACTIONS

	All Actions Complete

Prepared by: _____ Date: June 16 , 2017
Cristal Choi – Screenhouse Engineer

Reviewed by: _____ Date: 6 Sep 2017
Greg Budgen, Performance Engineering. Conv.

Approved by: _____ Date: 21-JUN-2017
Jason Wight – Director, Station Engineering Pickering

Approved by: _____ Date: 11/07/17
Donald Brazier – Director Controllership

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Station:	Project Name:	Project No.:	Units:	Controlled Doc No.:
Pickering	PA Fuel Channel Reconfiguration and East Shifting Tooling	49247/41023	P1 and P4	NA44-PIR-31120-00001

Approval	Cost	Date
Original Approval Estimate	$29,278k + $6,100k	2012-10-10
Approval Revision Estimate		
29,739 Final Approval Estimate	~~$29,195k~~ + $8,872k	2016-03-14
27,662 **Final Actual Project Cost** 8768	~~$29,739k~~ + ~~$8,766~~k ~~= $37,505k~~	2016-12-20
36,430		

Timing	
Target Date	U1-2012 U4-2015
Latest Approved i/s Date	U1-2015 U4-2016
In Service Date	U1-2015 U4-2016
Period used to calculate Performance result	

DELIVERABLES

Target	Achievement
Available Bearing Time (ABT) for Unit 1 and Unit 4 can reach end-of-life at 2020 with margin	Axial elongation limit (i.e. ABT) will be reached for unit 1 at 157055 EFPH. P2011 outage will begin at 151347 EFPH at which time FC shifting will allow for additional ABT. Reconfiguration achieved additional 39403 EFPH to 2020. Axial elongation limit (i.e. ABT) will be reached for unit 4 at 209936 EFPH. Reconfiguarion achieved additional 104958 EFPH to 2020.
Completion of fuel channel reconfiguration in scheduled time.	All reconfiguration work required additional time on critical paths which extended the overall outage. U1 work was scheduled for 14 days and was extended to 19 days because of additional criteria imposed by BCS. 51 hours were added to critical path with 43 hours outside of control of the project (Power failures, Fueling machine unavailable, etc.)Total of Reactor Face work was 21 days and 3 hours. U4 Reactor Face work was completed in approximately 12 days as originally planned
Maintain feeder to feeder clearance.	During channel shifting, some of the adjacent feeder to feeder and feeder to component clearances got reduced. Clearance between feeders must be maintained in order to ensure integrity of the feeders. Inspections are performed during the outages to ensure feeder clearances are being maintined for the operating intervals.
Dose uptake of less than 96 rem	Dose Targets were achieved successfully. Total expended dose was 79.7 rem. P1211 dose uptake 5.5 rem P1511 dose uptake 55.6 rem P1641 dose uptake 18.4 rem

QUALITATIVE RESULTS

Post Installation inspections and verifications are performed to ensure all the criteria met for RTS. The results must satisfy the RTS conditions.	Conditions of RTS were satisfied as all verifications confirm that the initial scope of the project was met. Ref. NA44-REP-31120-00002 – U1 AFS Report NA44-REP-31120-00003 – U4 AFS Report I-CORR-31120-0553502 - Inspection Bulletin - Reconfiguration of Fuel Channels During P1511

KEY LESSONS	
Project Delivery	Lessons Learned Reports for Unit 1 & 4: I-LLD-31100-50000, I-LLD-31100-50001, & I-LLD-31100-50002. Importance of good training mock-ups Importance on the simplicity of procedures
OPEX	Importance on the importance of implementing lesson learned. The procedures, tooling, design and team became progressively better from one outage to the next. The importance of OPEX from experienced staff members and the rigor and quality work by the team help complete the work successfully.
Teamwork	Importance of good working relationships between numerous workgroups, vendors and support organizations.
FOLLOW-UP ACTIONS	
	None

Prepared by: M. PASOR MP Date: 2020-05-11 Reviewed by: Date: 24-Feb-2020
Author Project Sponsor

Approved by: Melissa Hannon Date: 03/12/2020 Approved by: Date:
Project Approval Authority Finance Project Approval Authority

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41023_49247_49229.

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Station:	Project Name: Standby Boiler, 018-73210-BO1 Capacity Improvement	Project No.:	Units:	Controlled Doc No.:
Pickering		13-49267	018	NK30-PIR-73210-00001

Approval	Cost	Date
Original Approval Estimate	$6,129k	2014-10-31
Approval Revision Estimate	$6,429k	2015-10-31
Final Approval Estimate	$6,429k	2015-10-31
Final Actual Project Cost	$6,201k	2017-03-31

Timing	
Target Date	Nov 2015
Latest Approved i/s Date	Nov 2015
In Service Date	2015-11-04
Period used to calculate Performance result	Dec 2016 – Nov 2017

DELIVERABLES	
Target	**Achievement**
Upgrade existing 018-73210-PRV900 and 018-73210-PC900	Upgraded steam piping and replaced existing 018-73210-PRV 900 and 018-73210-PC 900. Installed flow meter to measure flow rate.
Portable pump and fittings available to supply lake water to boiler	Specified and procured portable diesel pump. Modified screen house grating to accommodate pump suction. Procured hosing to connect suction and pump discharge to boiler house piping.
Upgrade Boiler capacity to produce 47,000 lb/hr steam	Procured new tubes and fabricated as required. Removed boiler and shipped to OEM, removed all old tubes and replace with new tubes. Inspected, tested and certified by OEM.

QUALITATIVE RESULTS	
	018-73210-PRV900 and 018-73210-PC900 were replaced and AFS in Sept 2013. Portable diesel pump with suction and discharge hoses for contingency standby boiler feed water supply were procured, commissioned and AFS.
	Standby Boiler was re-tubed by OEM. Full load testing was conducted in Jan 2017 and demonstrated the boiler output delivered per rated capacity.

KEY LESSONS	
	Key Lessons were documented in Lessons Learn Report NK30-LLD-73210-00001 and NK30-LLD-70000-00001.

FOLLOW-UP ACTIONS	
	Not required

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Prepared by: John Law Date: FEB 12, 2019
Author

Reviewed by: J Thompson Date: Feb. 15, 2019
Project Sponsor

Approved by: Barb Kerr *Barbara Kerr* Date: February 19th, 2019
Project Approval Authority Finance

Approved by: R Geofroy Date: 25 FEB 2019
Project Approval Authority

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Station: Pickering	Project Name: Pickering Administration Building Rehabilitation	Project No.: 13-49284	Units: 0	Controlled Doc No.: NA44-PIR-28160-0805164

Approval	Cost	Date
Original Approval Estimate	$12,120k	2012-01-03
Approval Revision Estimate	$19,449k	2013-01-28
Final Approval Estimate	$19,449k	2013-01-28
Final Actual Project Cost	$18,133k	2014-05-27

Timing	
Target Date	2015-07-15
Latest Approved i/s Date	2014-06-30
In Service Date	2014-11-20
Period used to calculate Performance result	

DELIVERABLES	
Target	**Achievement**
Upgrade the Admin Building fire safety system to meet fire code.	Modifications required to correct fire/building code deficiencies as identified in Fire Protection Code Compliance Review Report (P-REP-28000-00001) were completed on 2012-12-12.
Upgrade the Admin Building HVAC system.	Modification/upgrade to the Admin Building HVAC system by installing two sets of new air handling units, new air distribution control system, and air balancing was completed on 2014-11-20.
Extend the lunch room seating area.	Lunch room seating extension completed and turned over to Operations on 2012-12-12.
Renovate the Admin Building entrance lobby.	Entrance lobby renovation completed and turned over to Operations on 2012-12-12.
Improve functionality and appearance of the court yard.	Courtyard landscaping completed and turned over to Operations on 2012-12-12.

QUALITATIVE RESULTS	
HVAC System Performance	Previous baseline was unstable indoor temperature (29 C) with a lack of humidity. System OBC/AHSRAE requirements and performance specifications now met. As per Commissioning Report P-CR-73830-00003 HVAC system maintains building at 22 C (+/- 2 C) while in occupied mode with 30% relative humidity.
HVAC System Maintenance	Baseline for this project was a high corrective maintenance burden. Before project completion, there was a large number of WO's on the Admin Building HVAC system, most of which were OM WO's for cooling/heating set point problems, passing valves and chiller failure. CM/OM WO's for the four years prior to project completion was compared with four years after project completion. Comparison shows that there was no significant change in CM WO's, this is attributed to the fact that the CM WO's were for faulty valves and issues with glycol make up. However, a decrease in incoming OM WO's was shown (down from 26 in 2011 to 5 in 2017 and 2018), this indicates the project intent was met.
Fire System and Life Safety Code Compliance	Previous baseline was gaps in mandatory NFCC/NBCC fire and life safety code requirements. Randall Brown identified gaps as per P-REP-28000-00001. Third Party Reviewer, PLC, identified that the project scope met the fire code requirements, see NA44-REP-28000-00002-R002. Subsequent letter, NA44-CORR-00531-06959, was sent to inform the CNSC of this project on the fire system.

KEY LESSONS	
Executing a Commercial Modification Inside the Protected Area is not Recommended	Intent was to install a modification with engineering performed by a firm outside of the ECC process and procurement/construction as a commercial contract. During installation, it was discovered that this type of commercial modification is difficult to implement because station support resources are not equipped/trained to execute modifications outside of the ECC process. An example was that new equipment originally did not have CAT IDS, eBOM, or equipment codes. Original justification for a commercial strategy was that the Admin Building system has isolation points that separate it from the station systems (see 44AB-REP-28160-00001 and 44AB-CORR-28160-0154260).
Poor Configuration Management	The configuration management of the system and components within the Admin Building were not well maintained. This resulted in incorrect inputs for design requirements. The original intent of the commercial project was to not update configuration management systems however the need to follow station work protection processes resulted in scope change and significant cost and delays. An additional discovery issue late in the project with blocked reheat coils resulted in the need for electric heaters as opposed to hydraulic reheat coils.
Inadequate Validation of Assumptions	The commercial design agency subcontracted the mechanical/electrical designs to another vendor. The resulting calculation for the cooling system serviced by chiller CH2000 in Building B was incorrect. This was because the specification provided to the vendor by OPG maintenance personnel was not validated in the field or validated by the subcontractor. An additional issue was that the new roof-top air handling unit ACU2978 had less cooling coil water flow than was specified. This was caused by a 4-way CV in the field that was assumed to be a 2-way valve based on information from the controls vendor and a lack of field verification. This resulted in delayed AFS while system performance was validated for a summer season.
Need to Heighten and Maintain Vigilance on Contract Change Control Processes	There was a significant amount of CCR process which occurred after the work was completed instead of being performed prior to work with project manager approval. Dedicated project resources were displaced to other station work without prior consultation or approval of the project manager.
Maintain Sound Project and Stakeholder Management	The project was executed without a formal work plan and stable schedule resulting in project delays and lost stakeholder confidence. Additionally, the requirement to use OPG station resources should have been identified earlier in the scheduling process; resources were often requested with little notice. Timely recovery schedule should have been quickly developed when issues arose.
Document Control	Poor project document control resulted in project schedule/cost overruns. This included not using the latest revision of the engineering drawings in the field and discovering that >100 electrical/control drawings were missed during the document scoping phase.
Reference	NA44-LLD-28160-00002, 13-49284 Admin Building Rehab Project Lessons Learned
FOLLOW-UP ACTIONS	
N/A	N/A

TITLE Post Implementation Review Template	Document Type: PIR	Page: 3 of 3

Prepared by: _____ Date: 09DEC 2019
Lowell Bower
Section Manager (Acting), Pickering Performance Engineering
Author

Reviewed by: _____ Date 8-JAN-2020
Jason Wight
Director Station Engineering
Project Sponsor

Approved by: Melissa Hannon Date: Jan 14/2020
Melissa Hannon
Finance Controller
Project Approval Authority Finance

Approved by: _____ Date: 24 JAN 2020
Richard Geofroy
Director Operations & Maintenance
Project Approval Authority

ATTACH BCS

_____ JAN 15, 2020
Barbara Kerr
VP Controllership

ONTARIO POWER GENERATION	Document Number: FIN-TMP-PA-002*	Revision: R02	Page: 1 of 2
	POST IMPLEMENTATION REVIEW TEMPLATE (For Simplified PIRs only)		

Station:	Project Name:	Project No.:	Units:	Controlled Doc No.:
Pickering	PA Class II Emergency Lighting	13-49296	1-4	NA44-PIR-56100-00001

Approval	Cost	Date
Original Approval Estimate	4,528K	23NOV2012
Approval Revision Estimate	N/A	N/A
Final Approval Estimate	4,528K	23NOV2012
Final Actual Project Cost	3,925K	20JUL2015

Timing	
Target Date	15DEC2014
Latest Approved i/s Date	31DEC2014
In Service Date	17JUL2015
Period used to calculate Performance result	17JUL2015 to Present

DELIVERABLES	
Target	**Achievement**
Address issue with 600V Class II emergency lighting circuits which was in violation of the Ontario Electrical Safety Code, Section 10-200(1) with Class II bus was being fed by the ISTB.	The Class II 600V emergency lighting circuits were part of a 3-phase 4-wire system. When the Class II bus was fed from ISTB, the lighting circuits would have unbalanced neutral current flowing through the ISTB bare station conductors back to the ISTB transformer neutral. This was in violation of the Ontario Electrical Safety Code (OESC), Section 10-200(1). It was also a potential safety hazard as bare grounding conductor would be exposed to staff with no barriers in place. The voltage regulating transformers (1/2/3/4-56100-VRG25/26 and 1/2/3/4-56110-VRG35/36) installed were 3-phase, delta/wye, with a solidly grounded neutral. The neutral current from the Class II lighting circuits would be carried back to the isolating voltage regulating transformer neutral. This is now in line with OESC and the safety hazard has been eliminated. There have been no SCRs or WRs related to the voltage regulators during the performance period evaluated.
Enhance performance and reliability of Class II emergency lighting circuits	ETAP analysis for the ISTB showed that under single bus operation with Pickering B U7 or U8 supplying generator terminal voltage less than 24.1 kV, voltage fluctuations may occur on the Class II bus that would cause emergency lighting voltage to fluctuate below its operating voltage margin. This may cause some of the emergency lighting not to operate. There have been no SCRs or WRs related to the voltage regulators during the performance period evaluated.
Full project scope delivered on time and on budget.	Project budget – 4,528K; Total Spent – 3,925K (13.3% under budget) Target AFS date – 15DEC2014; Actual AFS date – 17JUL2015 (7 months behind schedule)

QUALITATIVE RESULTS	
Health and Safety Performance	Three safety related SCRs were filed during the installation of the Class II voltage regulators: **P-2014-19581** - Worker pinches finger Project# 13-49296 PO 222478-0001 **P-2014-21450** - BM PO 222478-0001 Project 13-49296 CA II Emergency Lighting Tranformer Worker felt static shock **P-2014-34786** - B&M PO#222478-0001 Project#13-49296 Class II Lighting Project Worker Received Cut To Finger
Effective Work Planning and Cost Management	Installation and commissioning for this project were under budget and only slightly behind schedule. This delay is mostly due to the outage schedule. U1 voltage regulators could not be installed until P1511 which was after the target AFS date of 15DEC2014.

KEY LESSONS	
Realistic Target Date for AFS	The target AFS date did not condsider that the U1 voltage regulator would need to be installed during a Unit outage and the next realistic U1 outage would not be until P1511. Therefore the target of 15DEC2014 was unrealistic.
Increased Emphasis on Safety Culture	Three safety related SCRs were filed during the installation. Event free tools suchs as PJB, situational awareness and 2 minute drills must be known and understood by all staff and contractors before starting work.
FOLLOW-UP ACTIONS	
	No follow-up actions are required.

Prepared by: _____ Date: Dec 16/2019
Ali Raza – Class I/II System Engineer

Reviewed by: _____ Date: Dec 16/2019
Greg Bugden – Manager, Performance Engineering Conventional

Approved by: _____ Date: Dec 17/2019
Louisa Kwan – Director, Controllership

ATTACH BCS

ONTARIO POWER GENERATION	Document Number: FIN-TMP-PA-002*	Revision: R02	Page: 1 of 2
	POST IMPLEMENTATION REVIEW TEMPLATE (For Simplified PIRs only)		

Station:	Project Name:	Project No.:	Units:	Controlled Doc No.:
Pickering ✓	Radioactive Emission Reduction (Stack Monitors) ✓	13-49298 ✓	Pickering 1, 4 and 014	

Approval	Cost	Date
Original Approval Estimate	$9760K ✓	2NOV12
Approval Revision Estimate	$9468K	18JAN16
Final Approval Estimate	$12,446K ✓	09AUG17
Final Actual Project Cost	~~$11,092K~~ 10,413,866	03JUL12 MH 06/25/2020

Timing	
Target Date	28FEB17
Latest Approved i/s Date	7MAY18
In Service Date	7MAY18
Period used to calculate Performance result	2017 to 2018

DELIVERABLES

Target	Achievement
Reduce large variance between reporting of noble gas emissions to the public when compared to the offsite fence-line monitors.	Reporting of noble gas is consistent with the offsite fence monitors (As documented in Project Closure Report for Project 13-49298)..
Reduce the frequent Box-ups of the containment system due to aging and unreliable stack monitors.	There has been significant reduction in use of interim samplers and unit box-ups due to aging and unreliable stack monitors since the project has been implemented.
Ensure a good performing stack monitor system is available until the end of station life and decommissioning stage.	Required maintenance has reduced providing proof of a good performing stack monitor. Performance of Pickering B Stack Monitors has been very good since they were AFS'd. Minimal unavailability. Based on the good performance of these monitors it was recommended to replace U1, U4 and IFB-A stack monitors with same BOT Engineering make monitors.
Provide adequate spare parts to allow the system's health to be upgraded to and maintained as "GREEN" with the new system, since the components and spare parts for the old system were no longer available or manufactured (obsolete).	Adequate spare parts are available to upgrade maintain system health to White.

QUALITATIVE RESULTS

KEY LESSONS

Lessons learned captured in the following reports:	IFB-A Stack Monitoring System Available for Service, NA44-REP-67876-00114. (Appendix 1)
	RB U1 Stack Monitoring System Available for Service, NA44-REP-67876-00116. (Appendix 2)
	RB U4 Stack Monitoring System Available for Service, NA44-REP-67876-00115. (Appendix 3)
FOLLOW-UP ACTIONS	
N/A	No follow up actions as all key milestones to date as per the Full Release BCS have been completed.

Prepared by: Adil F. Doctor Date: 5 March 2020
Author

Reviewed by: Will St. Pierre Date: May 5, 2020
Project Sponsor

Approved by: _____ Date: _____
Project Approval Authority Finance

Approved by: _____ Date: _____
Project Approval Authority

ATTACH BCS

Melissa Hannon June 25, 2020

Barbara Kerr 30 June 2020

ONTARIOPOWER GENERATION	Document Number: FIN-TMP-PA-002*	Revision: R02	Page: 1 of 2
	POST IMPLEMENTATION REVIEW TEMPLATE (For Simplified PIRs only)		

Station:	Project Name:	Project No.:	Units:	Controlled Doc No.:
Darlington NGS	ESW Pipe and Component Replacement	10-73397	0	D-PIR-72800- 00002 R000

Approval	Cost	Date
~~Original Approval Estimate~~	~~2,000~~	~~11/05/2013~~ BB
Approval Revision Estimate Gate 3 est. BB	6,680	30/07/2014
Final Approval Estimate	6,680	20/07/2015
Final Actual Project Cost	6,363	26/10/2015

Timing	
Target Date	20/06/2015
Latest Approved I/s Date	5/06/2015
In Service Date	20/01/2016
Period used to calculate Performance result.	Period 3 ,2016

DELIVERABLES

Target	Achievement
Inspection results have confirmed that certain sections of the ESW pipe need to be replaced due to pipe wall thinning/pitting caused by internal MIC (corrosion). Several ESW valves also require replacement to ensure proper isolation for future refurbishment work. Execution of following scope was part of 2015 VBO to incorporate ESW Pipe and Component replacement as per NK38-SOW-72800-10007 -R02 and N-GRB 00120-0506610.	Actual: Replaced and Installed of new pipe and components: • Strainer Backwash piping in ESW Pump House • L15 ESW header Units 1/2/3/4 (V223 and immediately upstream and downstream) • L18 Unit ESW supply line to Steam Generators units 1 • L25 & L72 PAWCS HX inlet and outlet piping • 0-34200-TK4 • 0-72100-NV1113/1116 Associated WOs # 2254649, 2284537,2363883, 2750627, 2859912,3170818,Completed and Closed BB Sept 8/16
The ESW system is normally continuously operated in running standby mode. In this mode, the system supplies water to the Auxiliary Service Water System, the Irradiated Fuel Bay Heat Exchanges, and the Air Conditioning Units.	~~Expectations are that~~ The new replacement to the ESW systems ~~to~~ improves reliability to supply cooling water to selected safety related systems when normal water supplies are unavailable for the removal of decay heat and prevention of subsequent process failure.

QUALITATIVE RESULTS

Replaced affected portion of ESW system to mantain special safety qualificationas.	All affected pipe/component and insulation was replaced, affected systems been restored and return to service leak free.

KEY LESSONS

TITLE Post Implementation Review Procedure	Document Type: Procedure	Page: 2 of 2

FOLLOW-UP ACTIONS	
	None

Prepared by: _____ Date: Aug 29, 2016 Reviewed by: _____ Date: 30 Aug 2016
Author Project Sponsor
R. McCord – Manager Ops Prod NR.

Approved by: _____ Date: Sept 8/16 Approved by: _____ Date: Oct 12/2016
Project Approval Authority Finance Project Approv Authority
Brent Barnick, Controller, Darlington Brian Duncan
SVP Darlington
ATTACH BCS

ONTARIO POWER GENERATION

Records File Information:
For all projects, file in accordance with local project management governance
For capital projects, send a copy to Shared Financial Services/Asset Accounting
For PIRs, refer to OPG-PROC-0056; Retention: P

Internal Use Only

FIN-FORM-PA-005-R005*

Project Closure Report

This Project Closure Report (PCR) form is used for documenting relevant project closure information and approving the project closure decision in accordance with FIN-PROC-0030. It may also be used as a Post Implementation Review (PIR) report in accordance with OPG-PROC-0056, Post Implementation Review.

Part 1: Project Account Closure – Complete for all projects	
Is this PCR also used as a PIR report? Yes	**Records Document Number** (required only when the PCR is also used as a PIR report) NK38-PIR-44300-0826458
Project Executing Organization Components & Equipment Engineering Darlington	**Date** 23DEC2019
Project Number 80117	**Site / Location Name** Darlington Nuclear Generating Station
Project Title DN CEP Pump Motor Spares	
Project and Asset (if any) Description Procure two (2) Main Condensate Extracting Pump (MCEP) Motor Spares for Darlington Units	
Company Code / Business Area (Controller) OPG / Nuclear	**Asset Class (Controller)** NA
Super Asset Number (Controller) NA	**Super Asset Description (Controller)** NA

Part 2: Final In-Service Transfer – Complete for CAPITAL projects
Final In-Service Transfer Credit Account (Controller)

Part 3: Project Cost and Schedule Variance – Complete for all projects

	(1) Original Approved Estimate	(2) Current Approved Estimate	(3) Final / Actuals	(4) Variance (= 3 – 2)
Cost ($K)	4,500	4,500	4,404	-0,096
Schedule (In-service date)	2017-12-31	2017-12-31	2018-12-19	51 weeks behind schedule

Deliverables (Completed? Intended Functionality Achieved? Target vs. Actual?)

Two (2) MCEP motor spares (CID 997542-3) delivered on site. Project Completed and intended functionality achieved.

References or attached pages for:

- Listing in chronological order of all corresponding BCSs and of variance approvals – date and approval authority; and what approved – cost, schedule, and deliverables
- Reference the "lessons learned report"
- Discussion and analysis – cost, schedule, deliverables, and key lessons learned

D-BCS-44300-10001. Cost, schedule, and deliverables were approved on 09Jan2015.

*Associated with FIN-PROC-0030, Property, Plant and Equipment

Part 4: PCR Approval Signatures – Complete for all projects	
Project Manager: The project is declared closed. I confirm that all remaining materials (if applicable) of the project are appropriately dispositioned as spare parts to accepting business areas or are declared surplus. No costs shall be charged to this project at this point forward. **Controller for Project Organization (if applicable, i.e., the BU/Function has a Project Organization Controller):** I confirm the information documented in this PCR is correct.	
PCR Submitted by: Project Manager Vincent Cui Vincent Cui Assistant Technical Engineer/Officer Component &Equipment Engineering Darlington Nuclear 25MAR2020 **Date**	**PCR Reviewed by: Controller for Project Executing Organization** (if applicable) Shawn Klis, Controller Projects Name Title, Department, BU/Function 26Mar20 **Date**
Station / Plant Group / Function Controller: I confirm the information documented in this PCR is correct. **Asset Owner:** I authorize the decision to declare project closure for this project.	
PCR Reviewed by: Controller for Sponsoring Organization Brett Lemmon Brett Lemmon Controller Darlington Nuclear **Date** Mar 27, 2020	**PCR Approved by: Asset Owner or Sponsoring Organization Authority** Hassan Qadri Hassan Qadri Manager, Component & Equipment Engineering Darlington Nuclear **Date** Mar 30, 2020

Part 5: PIR Signature – Required only when the PCR is also used as a PIR report		
	Signature	**Date**
I have reviewed and accept the PIR results in this report.		
Reviewed by: Project Sponsor Hassan Qadri Manager Component & Equipment Engineering Darlington Nuclear		Mar 30, 2020

Part 6: Distribution – Required only when the PCR is also used as a PIR report
Distribution: When this PCR is also used as a PIR report, the Project Sponsor shall ensure distribution (cc) to the following personnel if they have not already signed off above: • Finance Approver in the BCS: John Sawler, Director, Controllership - Darlington • Line Approver in the BCS: Steve Gregoris, Director, Operations & Maintennance, Darlington • Other key stakeholders: Name, Title, Department, BU/Function

Part 7: PCR Checklist – Complete for all projects by Project CSA or Project Manager	
Checklist Item	**Checkbox**
All Tempus Work Events have been closed, including: • Assigned Tempus Work Events N/A • AS7 Work Order Task created work events N/A	☒ ☒
All PO/WO/MRs/CRs have been closed, including: • Request sent to AS7 buyer to close PO/COs after closing related MRs/CRs PO 267822 Closed • Request sent to Planner to close any AS7 Work Order Tasks N/A • Request sent to ONCORE to close all tasks and associated PO's N/A	☒ ☒ ☒
All Accruals have been cleared. Yes, confirmed with Finance	☒
Any purchases through purchasing cards (VISA) or Ariba Web Catalogue have been reconciled in Concur or shipped by Ariba Vendor. No such purchases made in the procurement	☒
All default Business Expense or VISA default accounts have been changed. N/A	☒
All spare parts have been set up in AS7, including: • Inventory by Cat ID with ROP/TMAX values Level 2 CIDs added for CID 997542 W/ New Item Group for processing • Capital Spares are set up in the appropriate Asset Class and account N/A	☒ ☒
All obsolete or surplus inventory or components have been identified and Surplus Declarations routed to ensure that all retired assets have been properly removed from the fixed asset ledger and inventory accounts. N/A	☒
The Super Asset Class, the Company Code, Super Asset Numbers agree with previous REIS. No previous REIS	☒
The Final Actual Costs and Current Approved Estimate agree with FRA and/or SAP. Yes, confirmed with Finance	☒
If this is combined PCR/PIR, it was defined in the approved BCS.	☒
If the Actuals are greater than the Approved amount, the overspend has been approved in accordance with the appropriate OAR Element specified in the BCS standard (OPG-STD-0076, Developing and Documenting Business Cases), with an approved OPG-FORM-0077, Project Over-Variance Approval or a Superseding BCS. N/A	☒
A copy of the FRA and/or SAP Report is attached.	☒

Project CSA / Project Manager (Sign-Off): I confirmed the completion of all the checklist items.		
Project Manager Vincent Cui Assistant Technical Engineer/Officer Component Engineering - Darlington	**Signature** Vincent Cui	**Date** 25MAR2020

ONTARIO POWER GENERATION

Records File Information:
For all projects, file in accordance with local project management governance
For capital projects, send a copy to Shared Financial Services/Asset Accounting
For PIRs, refer to OPG-PROC-0056; Retention: P

Internal Use Only

FIN-FORM-PA-005-R005*

Project Closure Report

This Project Closure Report (PCR) form is used for documenting relevant project closure information and approving the project closure decision in accordance with FIN-PROC-0030. It may also be used as a Post Implementation Review (PIR) report in accordance with OPG-PROC-0056, Post Implementation Review.

Part 1: Project Account Closure – Complete for all projects	
Is this PCR also used as a PIR report? Yes	**Records Document Number** (required only when the PCR is also used as a PIR report)
Project Executing Organization DNGS - Station Engineering	**Date** 28Jul2020
Project Number 16-82816	**Site / Location Name** DARLINGTON NUCLEAR GS
Project Title DN VAULT COOLING COIL REPLACEMENT	
Project and Asset (if any) Description Replacement of the reactor vault cooling coils in all units as they are nearing end of life and developing leaks.	
Company Code / Business Area (Controller) 9807	**Asset Class (Controller)** 15720000
Super Asset Number (Controller) 02151	**Super Asset Description (Controller)** DARLINGTON GS

Part 2: Final In-Service Transfer – Complete for CAPITAL projects
Final In-Service Transfer Credit Account (Controller)

Part 3: Project Cost and Schedule Variance – Complete for all projects

	(1) Original Approved Estimate	(2) Current Approved Estimate	(3) Final / Actuals	(4) Variance (= 3 – 2)
Cost ($K)	18,753	17,882	16,204	-1,678
Schedule (In-service date)	Sept 2020	N/A	April 2019	74 weeks ahead of schedule

Deliverables (Completed? Intended Functionality Achieved? Target vs. Actual?)

All cooling coils have been replaced during station outages. The last cooling coils were replaced in D1941. Since the replacement of the coils there have been no leaks identified in the RVAS. The coils will be replaced again during the unit refurbishment outages (DNRU2 replacements are complete).

References or attached pages for:

- Listing in chronological order of all corresponding BCSs and of variance approvals – date and approval authority; and what approved – cost, schedule, and deliverables
- Reference the "lessons learned report"
- Discussion and analysis – cost, schedule, deliverables, and key lessons learned

*Associated with FIN-PROC-0030, Property, Plant and Equipment

All cooling coils have been replaced during station outages. The last cooling coils were replaced in D1941. Since the replacement of the coils there have been no leaks identified in the RVAS. The coils will be replaced again during the unit refurbishment outages (DNRU2 replacements are complete).

D-BCS-73720-10001-R001

Adobe Acrobat Document

Key Lessons Learned:

1) Project was required due to emergent issues with leaking cooling coils, which were nearing end of life. Project scope increased to include all Vault Cooling coils due to extent of condition and severity of leaks.
2) This project was passed through many different System Engineers, and Section Managers (Project Managers) due to high turn over, which made it cumbersome to find latest information and previous project members.

Part 4: PCR Approval Signatures – Complete for all projects

Project Manager: The project is declared closed. I confirm that all remaining materials (if applicable) of the project are appropriately dispositioned as spare parts to accepting business areas or are declared surplus. No costs shall be charged to this project at this point forward.

Controller for Project Organization (if applicable, i.e., the BU/Function has a Project Organization Controller): I confirm the information documented in this PCR is correct.

PCR Submitted by: Project Manager	**PCR Reviewed by: Controller for Project Executing Organization** (if applicable)
20AUG2020 Jordy Mejia Saavedra Section Manager, Performance Engineering, Station Engineering Darlington **Date**	Shawn Klis **Controller, Projects and Modifications** **Date**

Station / Plant Group / Function Controller: I confirm the information documented in this PCR is correct.

Asset Owner: I authorize the decision to declare project closure for this project.

PCR Reviewed by: Controller for Sponsoring Organization	**PCR Approved by: Asset Owner or Sponsoring Organization Authority**
Brett Lemmon **Controller, Darlington** **Date**	Zar Khansaheb Director Station Engineering, Station Engineering Darlington **Date**

*Associated with FIN-PROC-0030, Property, Plant and Equipment

Part 5: PIR Signature – Required only when the PCR is also used as a PIR report		
	Signature	**Date**
I have reviewed and accept the PIR results in this report.		
Reviewed by: Project Sponsor Stewart Wilson Manager, Performance Engineering, Station Engineering Darlington		

Part 6: Distribution – Required only when the PCR is also used as a PIR report
Distribution: When this PCR is also used as a PIR report, the Project Sponsor shall ensure distribution (cc) to the following personnel if they have not already signed off above: • Finance Approver in the BCS: Name, Title, Department, BU/Function • Line Approver in the BCS: Name, Title, Department, BU/Function • Other key stakeholders: N/A

Part 7: PCR Checklist – Complete for all projects by Project CSA or Project Manager	
Checklist Item	**Checkbox**
All Tempus Work Events have been closed, including: • Assigned Tempus Work Events • AS7 Work Order Task created work events	 ☒ ☒
All PO/WO/MRs/CRs have been closed, including: • Request sent to AS7 buyer to close PO/COs after closing related MRs/CRs • Request sent to Planner to close any AS7 Work Order Tasks There are no open WO tasks. • Request sent to ONCORE to close all tasks and associated PO's Not required	 ☒ ☒ ☒
All Accruals have been cleared. There are no accruals on 82816	☒
Any purchases through purchasing cards (VISA) or Ariba Web Catalogue have been reconciled in Concur or shipped by Ariba Vendor.	☒
All default Business Expense or VISA default accounts have been changed.	☒
All spare parts have been set up in AS7, including: • Inventory by Cat ID with ROP/TMAX values Not required • Capital Spares are set up in the appropriate Asset Class and account 20 spare coils on hand.	 ☒ ☒
All obsolete or surplus inventory or components have been identified and Surplus Declarations routed to ensure that all retired assets have been properly removed from the fixed asset ledger and inventory accounts.	☒
The Super Asset Class, the Company Code, Super Asset Numbers agree with previous REIS.	☒
The Final Actual Costs and Current Approved Estimate agree with FRA and/or SAP.	☒
If this is combined PCR/PIR, it was defined in the approved BCS.	☒
If the Actuals are greater than the Approved amount, the overspend has been approved in accordance with the appropriate OAR Element specified in the BCS standard (OPG-STD-0076, Developing and Documenting Business Cases), with an approved OPG-FORM-0077, Project Over-Variance Approval or a Superseding BCS.	☒
A copy of the FRA and/or SAP Report is attached.	☒

Project CSA / Project Manager (Sign-Off): I confirmed the completion of all the checklist items.		
Project CSA or Project Manager Jordy Mejia Saavedra Section Manager, Performance Engineering, Station Engineering Darlington	**Signature**	**Date** 20AUG2020

ONTARIO POWER GENERATION	Document Number: FIN-TMP-PA-002*	Revision: R02	Page: 1 of 3
	POST IMPLEMENTATION REVIEW TEMPLATE (For Simplified PIRs only)		

Station: D	Project Name: DN X-750 Spacer Retrieval	Project No.: 80012 & 82949	Units: 2	Controlled Doc No.: NK38-PIR-31160-80112-0798543

Approval	Cost	Date
Original Approval Estimate	$13,620k	2015-03-27
Approval Revision Estimate	$19,407k	2015-09-30
Final Approval Estimate	$16,357k	2016-06-30
Final Actual Project Cost	$12,508k	2018-04-30

Timing	
Target Date	2018-11-30
Latest Approved i/s Date	2018-11-30
In Service Date	2018-04-30
Period used to calculate Performance result	1 year

DELIVERABLES	
Target	**Achievement**
24 spacers from 6 channels and all axial locations retrieved	Target achieved – all 24 spacers from 6 selected channels (N13, N15, O17, O21, O23 & O24) were retrieved.
Axial location and channel of each spacer is traceable, circumferential orientation is maintained and documented	Target achieved – all spacers retrieved were traceable and orientation documented.
All retrieved spacers arrive at testing facility without sustaining damage during transportation	Partially achieved – all spacers were transported to and received at the testing facilities. Some spacers were damaged during retrieval, but sufficient material was available for the scope of testing.

QUALITATIVE RESULTS	
	Retrieval and testing of these spacers provided data for assessment and modelling of the properties of the X-750 spacers in Darlington units. These spacers tested at the EFPH for DNRU2 support safe operation of D1, D3 and D4 to 220,000 EFPH, which formed part of the documentation to clear CNE Review Gate 4, as required in NK38-PLAN-31160-10000, "Long Term Darlington Life Management Plan for Inconel X-750 Annulus Spacers"

KEY LESSONS	
	Ref. NK38-ILD-31160-10000, DN X-750 Annulus Spacer Retrieval Lessons Learned

TITLE Post Implementation Review Procedure	Document Type: Procedure	Page: 2 of 8

NK38-PIR-31160-80112-0798543

FOLLOW-UP ACTIONS	
	None required. Testing and assessment of the spacers are covered under Project #83280, Annulus Spacer Life Management.

Prepared by: John Xiao Date: Oct. 11, 2019
Author

Reviewed by: Rick Hohendorf Date: Oct. 15, 2019
Project Sponsor

Approved by: Brett Lemmon Date: Oct 24, 2019
Project Approval Authority Finance

Approved by: Sean Granville Date: 2019/11/1
Project Approval Authority

ATTACH BCS