

## Type 2 Business Case Summary

Final Security Classification of the BCS: **Internal Use Only**

To be used for investments/projects meeting Type 2 criteria in OPG-STD-0076.

Part A: Project Information					
<b>Project #:</b>	OTTO0039	<b>Title:</b>	Replace Headgates and Rehabilitate Gains		
<b>Phase:</b>	Definition and Execution	<b>Release:</b>	Partial	<b>Records File:</b>	
<b>Facility:</b>	Otto Holden GS	<b>Class:</b>	Capital	<b>Investment Type:</b>	Sustaining
<p><b>Business Need:</b></p> <p>The business need is a reliable headgate system to provide asset protection for the generators. To meet this business need, the recommendation is to replace the end of life headgates and restore the associated headgate equipment.</p> <p>Otto Holden has eight generating units; each is equipped with two headgates which are installed into gains embedded into the concrete structure of the headworks. The headgates are asset protection devices used to shut off water supply to the turbines in case of emergency and are the last resort available to stop the generators. They are also used to isolate units during unit repairs and maintenance. It is important that the headgates and gains, including the integrity of the seals and the seal paths, be maintained in good working condition in order to ensure asset protection and work protection requirements.</p> <p>The headgates, embedded components and the hoist mechanisms are original from the early 1950's. Between 1990 and 2003, the headgates for all 8 units received life extension work. The work was conducted on Units 1-6 and 8 from 1990-98, while the work for Unit 7 was in 2003. The repairs were expected to extend the service life of the gates by approximately 15-20 years and to restore operating reliability to the headgates until the headgate replacement and embedded components rehab project initiates in 2014. Our experience is that the headgates were at end of life and was confirmed by the assessment (R-NA6-29550-0001) in 2011 (21 years after the previous repairs began), however the condition of the embedded parts was not ascertained. The inspection results revealed that there is significant leakage occurring from headgate seals and sills and also revealed several operational and maintenance issues related to the hoist assemblies. The resources required to examine the embedded components prior to the partial release would not be feasible recognizing there will be a unit outage to replace the headgates. The headgates' full functionality needs to be re-established by bringing the leakage rate within the acceptable range. In addition, previous drop tests results have revealed that at least one headgate does not drop to the sill under full load conditions and other units are experiencing significant leakage.</p> <p><b>This Partial Release of \$3,910k will fund the installation of new headgates and the required restoration or replacement of embedded components and hoist assemblies to new condition on one unit (G1) in 2014. The estimated total project cost at completion is \$24,599k.</b> As it was not possible to determine the condition of the embedded components during last inspection, this partial release is also required to determine the complete scope of the repair work required for the embedded components and hoist assemblies, validate our assessment of the hoist assemblies and to complete the technical specification and release quality estimate for the remainder of the project. The headgate replacement and the repairs of the embedded components and hoists for the remaining seven units are programmed to be executed during the Otto Holden unit overhauls which are scheduled to begin in 2015.</p>					
<p><b>Preferred Alternative: Replace headgates with new headgates and rehabilitate gains and hoists. Advance one unit to 2014 and execute the remaining unit headgate replacements during the unit overhaul outages beginning in 2015.</b></p> <p>The preferred alternative includes the replacement of all of Otto Holden's headgates with new headgates as well as the required repairs to the embedded components and the hoist assemblies. One unit will be completed in 2014 in advance of the unit overhauls and the remaining seven units will be completed during the unit overhauls between 2015 and 2022.</p> <p>The replacement of all of the headgates with new headgates is recommended due to the improved performance and increased life expectancy of new gates over the alternatives to refurbish the gates, delay the work, or to do nothing. Currently the headgates are past their end of life, including the life extension that was provided by previous refurbishments, and drop tests on two units have revealed performance issues. Improved performance and reliability of the headgates and components will ensure that the units can be dewatered for inspections and maintenance as well as provide additional asset protection if required in an emergency.</p> <p><u>The 2012-16 plan includes aligning all headgate replacements with the unit overhauls. The preferred alternative will require one additional planned outage above those planned for the unit overhauls. Due to the potential for discovery</u></p>					



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work, this alternative will provide the opportunity to determine the extent of the discovery work on the first unit and will reduce the financial and schedule risks associated with discovery work for the remaining seven units. There has been no known impact on the operations of the headgates from the concrete growth (AAR) issue at Otto Holden although it is present in the headworks area. Discovery work could also impact the schedule and cost of the unit overhauls. Completing the replacement and repairs on one unit in advance of the overhauls will provide the information necessary to ensure that the scope and costs of executing the work on the remaining units can be determined with higher confidence and will allow for the necessary coordination between this project and the upcoming unit overhauls.

### Base Case: Status Quo – No Project

The headgates are currently 60 years old. The initial expected service life was 50 years. They have been refurbished once; however they are showing signs of deterioration and leakage. Doing nothing is not recommended as the headgates' performance could deteriorate to the point where they are not able to shut off water supply to the turbines in case of an emergency or be used for dewatering the units for maintenance and/or inspection purposes. Previous drop tests results have revealed that at least one headgate does not drop to the sill under full load conditions and other units are experiencing significant leakage. This increases the risk of damage to the unit and/or other equipment, should an emergency require automatic isolation of the water passage.

### Alternative 2: Delay Work – Replace headgates and rehabilitate gains and hoists after unit overhauls

The headgates are currently past their end of life. Delaying the work could lead to increased leakage and further deterioration to the gains and hoists assemblies. Drop tests were completed on two units since the rehabilitation program in the 1990s. One headgate did not close all the way, while the others exhibited significant leakage. Based on these tests and the known age and condition of the headgates, it is not recommended to wait until after the unit overhaul program to initiate the headgate replacement. If the headgates are not replaced until after the unit overhauls, the headgates will be 20 years past their end of life before the replacement even begins.

This alternative is not recommended as it does not provide the asset protection required and may lead to increased costs due to further deterioration of the embedded components and the hoist assemblies. In addition, this alternative would require taking eight additional unit outages following the unit overhaul program which could be avoided by combining the headgate replacement with the overhauls for seven of the units.

### Alternative 3: Replace headgates and rehabilitate gains and hoists in advance of unit overhauls

The replacement of the headgates is the preferred option. Completing the unit headgate work in advance of the overhauls, however, will require additional planned outages and is not recommended. Replacing all of the headgates in advance of the unit overhauls would provide new headgates for each overhaul, however it would also result in 8 additional outages over the same period as the unit overhauls. The unit overhauls are approximately eight months in duration while an outage for headgate replacement and hoist/gain rehabilitation would require approximately 4-5 months. In order to minimize the outage time and maximize unit availability, completing the headgate replacement project in advance of the unit overhaul outages is not recommended.

### Alternative 4: Refurbish headgates and rehabilitate gains and hoists

Due to the age of the headgates, their design and the fact that the headgates have been refurbished previously, this option is not recommended. The headgates are original from the 1950s and have an estimated service life of 50 years. The headgates are approximately 60 years old and have exceeded their design life that was extended by previous refurbishments. Refurbishment is estimated at approximately 75% of the cost to replace the headgates with new headgates. In addition, headgate replacement would still need to be completed once the benefits of the refurbishment deteriorate. Since this would be the second time that the headgates were refurbished, it would likely not provide the same life extension. There is also a risk that major refurbishments will be required, beyond what was completed on previous refurbishments, which could increase the costs to the equivalent of replacing the headgates with new, without providing the benefits associated with new headgates such as improved design, performance, warranty and increased life expectancy.

#### Deliverables:

Definition and Partial Execution Phase Release deliverables will include:

- Technical Specification for Headgates and Sectional Gates
- Purchase of additional Sectional Service Gates required for executing headgate replacement project.
- Purchase of headgates and execution of headgate replacement and gain/hoist repair for one unit in 2014
- Technical Specification to complete scope identified in Charter for remaining seven units
- Release Quality Estimate for executing the remaining seven units

#### Milestones:

- Technical Specification for service gates and headgates
- Contract awarded for 1<sup>st</sup> unit
- Execution of one unit headgate replacement and gain/hoist repairs
- Full Release for execution of

#### Target Date:

- March 2013
- May 2013
- June 2014 - September 2014



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Full Execution Phase Release deliverables will include: <ul style="list-style-type: none"> <li>- Replacement of headgates and rehabilitation of the embedded components and hoists for the remaining seven units at Otto Holden in conjunction with the unit overhauls planned for 2015-2022.</li> </ul>	seven remaining units • Project Completion	• Q3 2014 • Q4 2021
<b>References:</b> <ul style="list-style-type: none"> <li>• OTTO0039 – Headgates Investigation (R-NA6-29550-0001 – R000)</li> <li>• Project Execution Plan – OTTO0039 – Replace Headgates and Rehabilitate Gains</li> <li>• Project Definition Charter – OTTO0039 – Replace Headgates and Rehabilitate Gains</li> </ul>		

Part B: Project Cash Flows									
k\$	LTD	2012	2013	2014	2015	2016	2017	Future	Total
Currently Released	0	0	0	0	0	0	0	0	0
Requested Now	-	410	1,048	2,452	0	0	0	0	3,910
Future Required	-	0	0	0	2,863	2,894	2,924	12,008	20,689
Total Project Cost		410	1,048	2,452	2,863	2,894	2,924	12,008	24,599
Ongoing Costs	-								
Grand Total		410	1,048	2,452	2,863	2,894	2,924	12,008	24,599
Estimate Class <sup>1</sup> :	Class 3		Estimate at Completion <sup>1</sup> :		\$24,599		OAR Approval Amount:		\$24,599
Additional Information on Project Cash Flows (optional):									

Part C: Financial Evaluation					
k\$	Preferred Alternative	Base Case	Delay Work	Alternative 3	Alternative 4
<b>Project Cost</b>	24,599	N/A	30,357	24,599 ?	62,822
<b>NPV (after tax)</b>	(14,303)	N/A	(14,713)	(17,901)	(16,452)
<b>Other (e.g., LUEC)</b>	N/A	N/A	N/A	N/A	N/A
<b>Summary of Financial Model Key Assumptions (see Guidance on this Type 2 BCS Form):</b> <ul style="list-style-type: none"> <li>• Outage required for headgate replacement is 5 months and will be scheduled during off-peak time.</li> <li>• New headgates have an expected service life of 50 years.</li> <li>• Refurbishment will extend the life of the gates 15 years, after which replacement would be required.</li> <li>• Refurbishment costs are approximately 75% of replacement costs.</li> <li>• Delay work (Alt 2) NPV includes probability of one headgate failure between 2013 and 2022. Costs to replace failed gate are included. Costs associated with potential equipment/unit damage resulting from a gate failure are difficult to quantify and were not included.</li> <li>• Base Case (Status Quo) – NPV not calculated. Potential consequences include damage to equipment, lost production, and action required to regain control of flow through the units, however the cost of these consequences has not been quantified. Based on drop test results to date, performance indicates that replacement is recommended.</li> </ul>					

<sup>1</sup> Estimate Class and Estimate at Completion are to be stated if known. Other supporting documentation such as a Summary of Estimate (SoE) may be attached. The SoE template can be found on the Finance BCS Toolkit website.

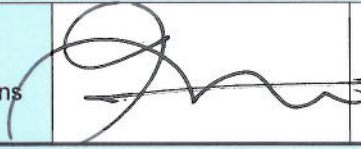


## Type 2 Business Case Summary

Part D: Risk Assessment				
Risk Class	Description of Risk	Risk Management Strategy	Post-Mitigation	
			Probability	Impact
Cost	Discovery work related to embedded components results in exceeding release amount	The partial release includes allowances for the scope recommended in the investigation report as well as discovery work. Contingency ( ) is also included. The partial release will fund the execution on one unit in order to finalize the scope and costs for the full execution release to complete the remaining units. Current costs estimates are based on budget estimate from vendor.	Medium	Low
Scope	Discovery work related to the imbedded components could increase the project scope	Discovery work is expected for the first unit which is to be completed with this partial release. The results from the first unit will be used to develop a detailed scope for the remaining units. Allowances and contingency have been made for the discovery work, and the schedule will be planned to ensure significant outage time is available to complete any discovery work.	Medium	Low
Schedule	Delay in ordering/receiving new headgates could impact execution	PEP and contract will include a schedule which will be the basis for the execution planning. Based on the estimated lead time of the headgates, sufficient time has been provided to order the headgates so that they are delivered prior to the start of the outage. Since the headgate replacement on the first unit does not coincide with a unit overhaul, the outage will be planned to ensure that the new headgates will be on site when required.	Low	Medium
Resources	Lack of resources	Labour assignment will be completed prior to awarding the contract for this project. Outage duration for the first unit can be adjusted to accomodate any delays.	Low	Medium
Quality/ Performance	New gates not performing as expected	A technical specification will be developed for the new headgates and the supplier will have experience with similar work at other OPG sites.	Low	Medium
Technical	Gate design does not meet technical requirements	A technical specification will be provided by OPG Hydro Engineering and the proposals will be reviewed by OPG to ensure that the proposed designs meet the technical specifications requested prior to awarding the contract.	Low	High
Other				



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Part E: Post Implementation Review (PIR) Plan				
Type of PIR		Target Project In Service Date	Target PIR Completion Date	
Simplified		2014-10-31	2014-12-31	
Measurable Parameter	Current Baseline	Target Result	How will it be measured?	Who will measure it? (person/group)
Improve headgate performance for emergency closure and maintenance isolation when dewatering the unit. Reduced leakage on first unit completed.	Current leakage has not been measured but was observed (visually) in the investigation and described as significant.	Leakage reduced as per requirements listed in the technical specification.	Leakage will be measured during commissioning and established as a new baseline.	Production, Project Management
Develop firm scope of work and costs for remaining units.	Current scope and costs based on estimates from vendor for replacement and assumed condition of embedded components.	Firm scope and execution phase costs estimates for remaining units.	Updated Project Scope documented in the Full Execution Phase Release Project Charter. Release Quality Estimate developed based on revised scope.	Asset Management & Technical Services - Programming
Scope	The scope for this Partial Release is outlined in the Project Definition Charter	Execute scope detailed in Project Charter.	Project officer to confirm the approved scope was completed as per the Charter.	Asset Management & Technical Services - Programming
Cost	The cost estimates for this phase of the project are included in the cash flow table of this BCS.	Execute the scope within the approved funding.	Actual costs to be compared to approved funds in this release.	Asset Management & Technical Services - Programming

Part F: Review/Approvals			
	Signature	Comments	Date
This BCS represents the best option to meet the validated business need in a cost effective manner.			
Recommended by: Frank Chiarotto SVP Hydro-Thermal Operations Project Sponsor		<i>funds for 2012 and 2013 are sufficient in the B.P.</i>	<i>Sept 25 2012</i>
I concur with the business decision as documented in this BCS.			
Finance Approval: Donn Hanbidge SVP & Chief Financial Officer			<i>Oct 9/12</i>
I confirm this project will address the business need, is of sufficient priority to proceed, and provides value for money.			
Approved by: Tom Mitchell President & CEO, per OAR 1.1			<i>OCT 16/12</i>



## Project Summary of Estimate

Date: August 29, 2012

Project #: OTTO0039

Facility name: Otto Holden GS

Project Title: Replace Headgates and Rehabilitate Gains

CAPITAL (\$K)	LTD	2012	2013	2014	2015	2016	2017	Future (2018- 2021)	TOTAL	%
Project Management/Engineering (010)	0	28	48	65	63	64	66	275	609	2
Consultant/Engineering (310)	0	0	0	0	0	0	0	0	0	0
<b>Construction/Installation</b>										
Hydroelectric (Plant Group Labour) (010)	0	12	24	69	70	71	73	306	625	3
Contractor/ (BTU labour)/EPSCA (310)	0									
Materials (200)	0									
Interest (700)	0	9	40	112	65	66	66	272	630	3
Contingency (998)	0									
<b>TOTAL (GROSS)</b>	<b>0</b>	<b>410</b>	<b>1,048</b>	<b>2,452</b>	<b>2,864</b>	<b>2,894</b>	<b>2,924</b>	<b>12,007</b>	<b>24,599</b>	<b>100</b>
<b>2012 Budget</b>	<b>0</b>	<b>25</b>	<b>100</b>	<b>200</b>	<b>1,950</b>	<b>1,964</b>	<b>2,000</b>	<b>10,000</b>	<b>16,239</b>	

- Notes: 1 Schedule: Start Date: October 2012  
 In-service Date: December 2014 (first gate), December 2021 (all gates)  
 2 Escalation rates are based on current allocation rates provided by Corporate Finance  
 3 Includes Partial Execution Phase Cost of: \$3,910k  
 4 Includes Removal Costs of: \$150k

Prepared by: Caley Griener	Approved by: Roy Van Clieaf
Project Engineer/Officer	Production/Project Manager
Date: Aug 29/2012	Date: Aug 30/12