D2-01-SEC-053-Attachment 2

Ref.	Project Name	Strategy	Strategy Description	Mitigated Risk Areas	Mitigated Risk Value (PV in $M)	Total Cost (PV in $M)	[Asset Investment Net Value (NPV) =Mitigated Risk Values (PV)+Financial Impact (PV)-Cost (PV)] ($M)
D2-T1-S3-Table 5a	**Tritium Removal Facility Life Extension and Tritium Removal Facility Cryogenic Refrirgeration System Hydrogen Compressor Upgrade**	Recommended Strategy	Carryout major refurbishment of the existing DTRF to improve reliability and availability and extend service life. It is recommended that major refurbishment of the existing DTRF be integrated with six (6) regularly scheduled extended outages that would be completed over a 12-year period of TRF operation, post 2025. This will allow the TRF to continue to operate on a regular schedule over the TRF refurbishment period. Current projects are in progress to ensure TRF will continue to operate during the refurbishment period post 2025.The final scope of work for TRF Life extension needs to be proposed, challenged, and accepted based on risk to continued reliable plant operation and cost. The screening and approving process should be similar to the process used for unit refurbishment scope to initiate a program for TRF refurbishment.The refurbishment scope would include: * Replacement / refurbishment of key heat exchangers to increase throughput. * Replace existing 2 x 50% duty compressors with 2 x 100% duty compressors to lengthen operating time between outages (improve reliability and capacity factor). * Replace service water piping to reduce leaks and increase reliability. * Add redundancy to key instrumentation and double isolation points where warranted to increase reliability and maintainability * Replace aged and obsolete; transmitters, sensors, transmitters, heaters, etc. as identified in the CCA. * Replacement of Cry absorbers toward end of refurbishment program.	Financial Risk	1000.4	145.0	1360.7
				Radiological Risk	240.1		
				Environmental Risk	210.1		
				Reputation & Social License Impact	12.5		
				Regulatory Risk	5.8		
				Financial Impact	36.8		
				TOTAL	1505.8		
		Alternate Strategy 1	Design and build a new Tritium Removal Facility (TRF) at the Darlington site based on current process and technology (as used in tritium removal facilities in Korea and Romania). The cost of a new build consists of intensive capital expenditures. Building a new TRF, is expected to take 10 years from start to finish. OPG will maintain full control over the overall process: planning, design, procurement, installation, commissioning and close-out. Assuming the first phase (planning) starts in 2020, close-out would not be expected until 2030, which is outside the schedule tolerance of 2-4 years beyond EOL 2025. A bridging strategy or partial life extension may be required at an extra cost. Locating the facility at DNGS would be challenging as there is no unused real-estate around the existing TRF. This may also require a new environmental assessment and/or a revision to site license.	Financial Risk	1113.5	576.3	1087.0
				Radiological Risk	318.0		
				Environmental Risk	318.0		
				Reputation & Social License Impact[1]	-63.6		
				Regulatory Risk[1]	-66.8		
				Financial Impact	44.2		
				TOTAL	1663.4		
		Alternate Strategy 2	**No other viable alternate strategy**	N/A	N/A	N/A	N/A
D2-T1-S3-Table 5a	**Powerhouse Cranes Refurbishment**	Recommended Strategy	For the DNGS 20 cranes, refurbish 18 cranes (Vault, Reactor Deck, Pumphouse Gantry, Irradiated Fuel Bay, Flask Handling) and perform outstanding refurbishment activities for the 2 Turbine Hall cranes currently undergoing a Controls Upgrade. This will ensure safe, reliable and economical crane performance during Refurbishment and for ongoing operation until Darlington's end of life.The Scope of Work (SOW) for refurbishment would include elimination of cab (where applicable), rail inspection, new motors, gear boxes, brakes, and wire ropes. The Recommended Strategy prioritizes crane refurbishments to reduce equipment reliability risk. It allows for completion of up to 14 cranes during the business planning period and deferral of the remaining crane refurbishments until after 2026. An alternative strategy of refurbishing all 20 cranes during the business planning period was considered previously and is no longer an option.	Reputation & Social License Impact	57.4	54.7	150.8
				Regulatory Risk	57.4		
				Financial Risk	46.5		
				Lost Generation Risk	36.5		
				Conventional Safety Risk	6.1		
				Radiological Risk	1.4		
				Nuclear Safety Risk	0.2		
				TOTAL	205.6		
		Alternate Strategy	An alternative strategy of refurbishing all 20 cranes during the business planning period was considered previously and is no longer an option.	N/A	N/A	N/A	N/A
D2-T1-S3-Table 5a	**Ventilation & Air Conditioning Fans Replacement**	Recommended Strategy	It is recommended to perform a one-time replacement of these fans as well as their associated dampers, heat exchangers (as applicable), and control instrumentation. This replacement will avoid significant failures, mitigate the conventional and radiological safety risk, and prevent resulting station impact. This strategy was identified by benchmarking with industry peers, and reviewing station OPEX (catastrophic failures, loss of margin, stall condition, shaft failures, etc.) Failure of fans in this group can impact steam protection, safety-related equipment cooling, and start a station shutdown clock. It is expected that the failure rate will increase unacceptably before station EOL without proactive replacement. Further, there are opportunities to transition this equipment to condition based maintenance with newer components which are digitally instrumented, and carry the potential for significant maintenance savings.	Financial Risk	914.1	21.7	1723.5
				Conventional Safety Risk	426.6		
				Nuclear Safety Risk	134.1		
				Radiological Risk	134.1		
				Regulatory Risk	134.1		
				Environmental Risk	2.4		
				TOTAL	1745.3		
		Alternate Strategy	**No viable alternate strategy**	N/A	N/A	N/A	N/A

1. Reputational & Social License as well as Regulatory risks increase due to requirement for Environmental Assessment Process.

Ref.	Project Name	Strategy	Strategy Description	Mitigated Risk Areas	Mitigated Risk Value (PV in $M)	Total Cost (PV in $M)	[Asset Investment Net Value (NPV) =Mitigated Risk Values (PV)+Financial Impact (PV)-Cost (PV)] ($M)
D2-T1-S3-Table 5a	**Public Address System Upgrade**	Recommended Strategy	It is recommended to replace existing amplifiers and speakers; install new speakers to improve coverage; and, install strobe lights to ensure that the PA system is reliable and fully compliant with CSA N293-12 (2017). Continuing to repair the existing PA system, is not sustainable as it is expected that the PA system will become unrepairable within the next few years, which will result in emergent replacement and potential for regulatory actions.Completing the Recommended Option will: 1) Reduce maintenance burden 2) Allow new buildings to tie into the system and expand the coverage of the existing system 3) Ensure code compliance with CSA N293-12 Scope of Work: In order to be fully compliant with CSA N293-12, the following upgrades to the Public Address (PA) System is required: (1) Replace all equipment with new (including approximately 1300 speakers [note: approximately 200 speakers (4 units x 50 speakers) require an outage to access], 17 Amplifier units) with Underwriters Laboratories Canada (ULC) approved rating. (2) Install Strobe Lights in high noise areas of the station (estimated 20 locations). (3) Enhance audibility coverage by including missed areas in the station (estimated 20 locations). (4) Enhance cable, equipment and speakers supervision as required by code.	Conventional Safety Risk	95.5	25.7	159.8
				Radiological Risk	30.0		
				Regulatory Risk	30.0		
				Reputation & Social License Impact	30.0		
				TOTAL	185.4		
		Alternate Strategy	**No viable alternate strategy**	N/A	N/A	N/A	N/A
D2-T1-S3-Table 5a	**Breathing, Instrument and Service Air Compressor Replacement**	Recommended Strategy	Option 2 is a proactive replacement strategy. Replace existing compressors with a newer model. All 19 compressors should be the same model to reduce maintenance complexity. Pickering OPEX has been considered where they are replacing their existing compressors due to obsolescence and procuring new replacement compressors as their strategy. Purchasing a greater quantity of compressors has the potential to reduce the overall unit cost of each of them. DNGS should also look to collaborate a replacement strategy with industry if the opportunity exists and is deemed beneficial. Consideration should also be given to purchase all of the compressors at the same time. This is to ensure a commonality of each of the compressors and sub components within them across the fleet. An alternative strategy of always maintaining spares (4 initially) and replacing compressors as they fail was considered in previous years but is no longer feasible.	Lost Generation Risk	463.9	22.5	1323.4
				Radiological Risk	390.6		
				Regulatory Risk	123.1		
				Nuclear Safety Risk	122.8		
				Reputation & Social License Impact	122.8		
				Environmental Risk	122.8		
				TOTAL	1345.9		
		Alternate Strategy	An alternative strategy of always maintaining spares (4 initially) and replacing compressors as they fail was considered in previous years but is no longer feasible.	N/A	N/A	N/A	N/A
D2-T1-S3-Table 5a	**Condenser Circulating Water, Emergency Service Water & Low Pressure Service Water Expansion Joints Replacement**	Recommended Strategy	Proactively replace all expansion joints like-for-like or similar. These expansion joints need to be replaced to ensure reliable operation of DNGS following refurbishment to the end of life. ESW and LPSW expansion joints can be replaced on-line. CCW expansion joints require an outage.	Lost Generation Risk	44.5	14.8[2]	158.3
				Financial Risk	44.5		
				Conventional Safety Risk	42.0		
				Reputation & Social License Impact	42.0		
				TOTAL	173.1		
		Alternate Strategy	**No viable alternate strategy**	N/A	N/A	N/A	N/A
D2-T1-S3-Table 5b	**PRECISE-WET (PREcise Circumferential Sampling Equipment - WET) Machine Delivered Scrape**	Recommended Strategy	Option 2 is to develop the Precise Wet tool to integrate with the RDM at Darlington as an alternative to CWest. This project is expected to take 5-6 years following the successful deployment of Precise Damp at Darlington in early 2021. The Precise Wet version of the tool is delivered by the RDM, while the damp version of the Precise tool is delivered manually. Since the base design of the both "wet" and "damp" version of the tool stays the same, therefore the functionality of the Precise-Wet tool would be proven after deploying the existing damp version of the tool during the D2011 outage. Given that the Precise-Wet tool functionality will be proven out before incurring expenditures against this investment, the risk of the investment is reduced significantly. Additionally, the vendor has performed successful trials of the Wet tool on mock-ups.	Financial Risk	22.0	18.2[2]	5.7
				Lost Generation Risk	1.6		
				Regulatory Risk	0.3		
				TOTAL	23.9		
		Alternate Strategy	**No viable alternate strategy**	N/A	N/A	N/A	N/A

2. The undiscounted cashflows for the investment are greater than $20M.