

<p align="center">Hopkinton Hydro Project 2008 Capital and Efficiency Improvements</p>						
<u>No.</u>	<u>Description of Improvements</u>	<u>Description of Improvement Benefit</u>	<u>When Completed</u>	<u>Age at Time of Refurbishment</u>	<u>New Useful Life</u>	<u>Total Cost</u>
2008-1	Installed new 24-inch exhaust fan with thermostat and floor fans.	Keeps generators cool to prevent plant from shutting down due to overheating of powerhouse. Installed floor fans with thermostatic control. Turbine/generator units used to shut down when powerhouse temperature exceeded 130°F	May 2008	[REDACTED]	[REDACTED]	[REDACTED]
2008-2	Installed new leaf boom.	Minimized debris on rack, increase production and reduce need for maintenance. Racks would clog and plant would shut down. Major improvement in production.	May 2008	[REDACTED]	[REDACTED]	[REDACTED]
2008-3	Replaced valve gaskets on G1 and G2 safety air valves.	Rebuilt safety air valves that are used to reduce torque on turbine. Valves were leaking causing substantial loss on production. Required piece of equipment to maintain safety of plant to reduce torque on turbine during shutdown and emergency shutdown. Now included on normal shutdown to protect equipment.	Jul. 2008	[REDACTED]	[REDACTED]	[REDACTED]
2008-4	Rewound burned out coil on G2 air valve.	Safety air valve was not functional but is required equipment for plant operations. Rebuilt safety air valves are used to reduce torque on turbine. Required piece of equipment to maintain safety of plant to reduce torque on turbine during normal and emergency shutdown. Now included on normal shutdown to protect equipment.	Jul. 2008	[REDACTED]	[REDACTED]	[REDACTED]
2008-5	Replaced couplings on G1 and G2 speed tachometer. ³	Continual failure of tachometer would shut plant down and reduce production. Replaced couplings and motor to keep plant on line and running. Dramatic increase in production, as this was a common failure.	Sep. 2008	[REDACTED]	[REDACTED]	[REDACTED]
2008-6	Installed new tachometer-Servotek. ⁴	Continual failure of tachometer would shut plant down and reduce production. Replaced motor to keep plant on line and running. Dramatic increase in production, as this was a common failure. Plant used to stock broken spare parts on shelf. Production is increased by	Sep. 2008	[REDACTED]	[REDACTED]	[REDACTED]

¹ “New piece of equipment”-indicates that the plant did not have this vital piece of equipment installed for reliable operation prior to 2008.

² Plant was purchased in 2008 by Petitioner. A 24-year period indicates that the equipment was past its useful life, and that refurbishment replaced original equipment

³ See item 2008–15 for information on final refurbishment of this piece of equipment.

⁴ See item 2008–15 for information on final refurbishment of this piece of equipment.

		keeping stock of working critical spare parts on hand.				
2008-7	Installed new vacuum contactor bottles g1 and g2.	Thermal imager enabled us to locate main vacuum contactor bottle overheating. Replaced before imminent failure. Stocked spare vacuum contactor, with spare bottles.	2010			
2008-8	Purchased thermal imager,	Purchase thermal imaging device for continual inspection and monitoring of plant. Thermal imager has enabled problems to be discovered before they become critical. Has prevented shutdowns and increased production. Gives us time to locate and purchase replacement products for repair, while still being on line and operating. Major increases in production.	2012			
2008-9	Installed new 100 cfm Ingersoll Rand gas powered compressor.	Made trash rack cleaning safer and more efficient for operators, reduced head loss, increased production, cut down time for operators	Aug. 2008			
2008-10	Refurbished left side of dam facing upstream.	Reduce leakage, improved structural stability of dam, enable project to keep operating. Required and necessary to ensure longevity of dam structure.	Sep. 2008			
2008-11	Refurbished trash racks.	Original trashracks were corroded and had reduced spacing due to thick rust and corrosion, thus reducing production and increasing headloss. Headloss was often over 1 foot through the racks, even when racks were cleaned. Major increase in production.	Oct. 2008			
2008-12	Installed new motion sensor light and handrail.	Improved safety for operators and safety of other personnel, reducing risk of fall injury.	Oct. 2008			
2008-13	Built and installed new 12V dc backup power supply.	Enabled plant to be safely shut down when grid power was down. This is a required emergency backup system; there was no system in place before installation. Without DC UPS 12V system facility cannot experience a controlled shutdown of the turbines during a loss of power.	Nov. 2008			
2008-14	Installed new Basler 3-P digital relay.	Required upgrade by PSNH to maintain plant on line. Old relay deemed obsolete by utility, extended life of facility by protecting plant during grid instability.	Sept. 2008			
2008-15	Ordered new digital tachometer and proximity sensor for G2 I	Plant was blowing 250 amp fuses due to inaccurate signal from speed tachometer, causing instability in generation, and throwing plant off line. Old tachometer system was functionally obsolete. There was no feedback on cause of outage. New tachometer brought plant to industry standard using digital controls.	Dec. 2008			
2008-16	Installed 1/3 hp 3-phase fan motor with seized	Critical component for cooling of gearbox, increased useful life span of gearbox. Existing motor was industry standard, but not functioning. Cleaned cooling mechanism-which was clogged due to lack of	Nov. 2008			

	bearings on G2 with new motor.	maintenance. Increase overall efficiency of cooling of gearbox oil. Prevent overheating which can result in significant turbine efficiency loss				
2008-17	Replaced level sensor pressure transducer, installed dessicant with low wattage light bulb.	Replaced level sensor which is main control component of plant for reliable operation. Upgraded cabinet with dessicant and heating device to keep moisture out of new transducer, increasing useful life span of transducer.	Nov. 2008	██████	██████	██████
2008-18	Installed new Watt-hour meters on G1 and G2.	Watt-hour meters had reached end of useful life and needed replacement with industry standard.	Nov. 2008	██████	██████	██████
2008-19	Replaced saturated meter per PSNH requirements.	Plant had increased production due to upgrades so that existing meter was not able to accurately read production. Utility required meter to be changed to accurately read production.	Sep. 2008	██████	██████	██████
2008-20	Replaced transducer in G1 with new Crompton Paladin transducer-Spectrum Industries.	Transducer drives watt meter and is used to record production. Transducer had reached end of useful life span. Required replacement, New transducer meets industry standard and is part of shutdown mechanism to protect from overpower and underpower of generators.	Dec. 2008	██████	██████	██████
2008-21	Installed new spooler on gate 3	Replaced hydraulic spooler, part of gate control system, required to keep plant safely operational.	Dec. 2008	██████	██████	██████
	Total Costs					██████

<p align="center">Hopkinton Hydro Project 2009 Capital and Efficiency Improvements</p>						
<u>No.</u>	<u>Description of Improvements</u>	<u>Description of Improvement Benefit</u>	<u>When Completed</u>	<u>Age at Time of Refurbishment</u>	<u>New Useful Life</u>	<u>Total Cost</u>
2009-1	Ordered new TR5000 from electro-sensors for G2. Installed in April 2009.	Brought second unit up to industry standard with replacement of mechanical tachometer with digital tachometer with higher accuracy and safety settings to protect from underspeed and overspeed, required to put induction unit on line at right time. Longevity advantage for synching unit with grid.	April 2009	██████████	██████████	██████████
2009-2	Installed new digital KW meter on G1.	Provides more accurate reading of output, and more reliable trip setting and shut down relay to determine when plant shut down during power production. Protects equipment from cavitation due to low flows. Bring up to industry standards with use of digital device.	Jan. 2009	██████████	██████████	██████████
2009-3	Installed new air compressor starter solenoid (new starter motor in 11/09; new solenoid in 12/09).	Keeps air compressor running which is integral part of keeping trash racks clean and maintaining production.	Dec. 2009	██████████	██████████	██████████
2009-4	Ordered new fan motors for G1 and G2 after G2 replacement motor burned out.	Critical component for cooling of gearbox, increased useful life span of gearbox. Existing motor was industry standard, but not functioning. Cleaned cooling mechanism, which was clogged due to lack of maintenance. Increased overall efficiency of cooling of gearbox oil. Prevents overheating which can result in significant loss of turbine efficiency.	Dec. 2009	██████████	██████████	██████████
2009-5	Installed new gate limit switches (ordered 2 spare switches).	Critical component for operation of plant,. Without limit switch working, gates would not function and plant could not operate. Had reached end of previous useful life and was replaced with industry standard.	Nov. 2009	██████████	██████████	██████████

¹ “New piece of equipment”-indicates that the plant did not have this vital piece of equipment installed for reliable operation prior to 2009.

² Plant was purchased in 2008 by Petitioner. A 25-year period indicates that the equipment was past its useful life, and that refurbishment replaced original equipment

2009-6	Modified gates for single gate operation.	Reconfigured gate operation by installing new controls (see item 2009-5), increasing production particular during low flows.	Jan. 2009	[REDACTED]	[REDACTED]	[REDACTED]
2009-7	Posted new dam danger signs.	Brought facility into minimum compliance with FERC dam safety requirements.	May 2009	[REDACTED]	[REDACTED]	[REDACTED]
2009-8	Installed new small center fan and set up thermostat for floor fans.	Keep generators cool to prevented plant from shutting down due to overheating of powerhouse. Install floor fans with thermostatic control. T/G units used to shut down for overheating when powerhouse temperature exceeded 130°F	Apr. 2009	[REDACTED]	[REDACTED]	[REDACTED]
2009-9	Installed new fuses on transducers in cabinets.	Fuses protect transducers during faults; thus, reducing catastrophic damage to control panel and reducing risk of system failure	Dec. 2009	[REDACTED]	[REDACTED]	[REDACTED]
2009-10	Refurbished G2 gearbox, redipped G2 generator windings and brake coil, installed new bearings and on generator shaft.	Major overhaul of gearbox and generator winding required to extend previous useful life and reliability of unit. Anticipated to last for additional decade or more.	Sep. 2009	[REDACTED]	[REDACTED]	[REDACTED]
2009-11	Installed new smoke detector and hooked up to sensor 3 of sensaphone warning system	Installation of new smoke detection system for early warning of any conditions that produce smoke in powerhouse. Attached to powerhouse alarm system that notifies operator of problem.	Sep. 2009	[REDACTED]	[REDACTED]	[REDACTED]
2009-12	Installed new frazil timer.	Frazil timer relay circuitry installed to accommodate delayed start in winter when frazil ice is present to increase production when normally plant would shut down.	Dec. 2009	[REDACTED]	[REDACTED]	[REDACTED]
2009-13	Repacked gate cylinders and new bushings on two cylinders, straightened one bent cylinder and replaced badly pitted cylinder with new chrome	Major overhaul of hydraulic gate cylinders required to extend useful life and reliability of gates. Anticipated to last for more than a decade if limit switches and other components are maintained.	Dec. 2009	[REDACTED]	[REDACTED]	[REDACTED]

	plated stainless steel cylinder.					
2009-14	Replaced rotten beams in forebay in front of G1 gates.	Improved safety for operators and safety of other personnel, reducing risk of injury to personnel and equipment	2009			
2009-15	Installed new floating bobble line for boat barrier at dam.	Upgrade existing system to replace inefficient system, reducing labor costs and increasing safety. Upgraded to minimum conditions of FERC license.	2009			
2009-16	Replaced turbine bearing bolts on G2.	Replacing broken bolts prevented major failure of bearing which would have caused catastrophic failure and taken plant off line for indeterminate period of time. Grease line repaired, so bearing now gets grease-which will protect bolts.	Jul. 2009			
2009-17	Replaced burned terminals on primary powerhouse panel.	Drastically improved reliability of control system, facilitating increased production due to reduction of nuisance tripping of control equipment for both units.	Dec. 2009			
	Total Costs					

Hopkinton Hydro Project						
2010 Capital and Efficiency Improvements						
<u>No.</u>	<u>Description of Improvements</u>	<u>Description of Improvement Benefit</u>	<u>When Completed</u>	<u>Age at Time of Refurbishment</u>	<u>New Useful Life</u>	<u>Total Cost</u>
2010-1	Installed new vacuum contactor bottles G1 and G2.	Thermal imager enabled locating main vacuum contactor bottle before overheating and replacement before failure. Stocked spare vacuum contactor with spare bottles.	2010	████████	████████	████████
2010-2	Installed new overspeed protection.	Installed overspeed protection. Previously, there was no overspeed protection on generators. Lack of overspeed protection could have caused a major failure that will cause a loss of production and large expense.	Nov-10	████████	████████	████████
2010-3	Installed new starter on HPU motor.	Installed to prevent failure. Maintains operations of gates that are critical component to safe and productive operation of plant. Without replacement of main hydraulic unit failure could have limited future operation.	Jan-10	████████	████████	████████
2010-4	Installed new Electrosensor 5000 on G1.	Brought first unit up to industry standard with replacement of digital tachometer with higher accuracy and safety settings to protect from underspeed and overspeed conditions, required to put induction unit on line at right time. Longevity advantage for synching unit with grid. Intermittent problem-resolved with replacement with same unit	Apr-10	████████	████████	████████
2010-5	Replaced oil flow sensors.	Replaced with current industry standard solid state oil flow detection device. Sensor monitors critical flow of oil through the gearbox, preventing overheating and seizure of the gears. Sensor extends anticipated life of gearbox.	May-10	████████	████████	████████
2010-6	Installed new thermostat on gearbox.	Upgraded old analog temperature sensing devices with new digital programmable thermostat relay. Thermostat gives more accurate and reliable feedback to the controls and provides critical protection of units.	May-10	████████	████████	████████
2010-7	Installed lightning arrestors on GI	Installation of lightning surge arrestors on main switchgear, Adds protection to the main power source of the plant.	May-10	████████	████████	████████

¹ Plant was purchased in 2008 by Petitioner. A 26-year period indicates that the equipment was past its useful life, and that refurbishment replaced original equipment

² “New piece of equipment”-indicates that the plant did not have this vital piece of equipment installed for reliable operation prior to 2010.

	and G2.					
2010-8	Installed fuses in control cabinets.	Fuses protect potential transformers during faults, reducing risk of both catastrophic damage to control panel and system failure	May-10			
2010-9	Installed G2 safety air valve system operating on compressed air.	Coil had failed, been replaced and then failed again. New system designed to operate on compressed air. Increase longevity of valve assembly and operation. Critical component for reducing torque on turbine. Upgraded to industry standard using readily available components.	Aug-2010			
2010-10	Installed new flexible grease lines to G2 runner bearing.	Grease lines maintain grease to bearing. Without replacement, catastrophic failure could have occurred due to lack of grease to turbine, shortening operating life of bearing. Failure to do so would result in complete facility shutdown.	Jul-10			
2010-11	Replaced G1 glass flow meter.	Replacement of glass required to ensure proper reading and prevent damage to gearbox.	May-10			
2010-12	Rebuilt grease pump.	Grease flow to main bearing was insufficient; refurbishment of grease pump enabled proper operation and increased operating life of lower bearing.	May-10			
2010-13	Rebuilt dipsticks.	With upgraded dipsticks, improved maintenance and operating life of gearboxes	Dec-10			
2010-14	Replaced hydraulic lines to gates.	Enables gates to operate at higher head and colder temperatures	Aug-10			
	Total Costs					

Hopkinton Hydro Project						
2011 Capital and Efficiency Improvements						
<u>No.</u>	<u>Description of Improvements</u>	<u>Description of Improvement Benefit</u>	<u>When Completed</u>	<u>Age at Time of Refurbishment</u>	<u>New Useful Life</u>	<u>Total Cost</u>
2011-1	Refurbished gates with UHMW adhesive on downstream side of gates.	Required refurbishment. The lifespan and functionality of gates had decreased almost to point of limited usability. Refurbishment averted over \$50,000 for new gates, thus avoiding down time and increasing production and reliability.	Mar. 2011	██████	██████	██████
2011-2	Installed new oil pump on G1 gearbox.	Replaced with new oil pump which moves oil through the gearbox, preventing overheating and seizure of the gears and extending anticipated life of gearbox.	May 2011	██████	██████	██████
2011-3	Tested gearbox oil through Signum for synthetic oil.	Adopted new oil test program to reduce overhead costs and premature oil replacement and to monitor the condition of gearbox and HPU.	Mar. 2011	██████	██████	██████
2011-4	Installed new metal roof.	Old roof had reached end of previous useful life.	Aug. 2011	██████	██████	██████
2011-5	Replaced seal on G2 at base of generator.	Replaced oil seal with industry standard. Replaced original factory seals with higher temperature seals to increase longevity and life expectancy of seals which are critical to containment of oil in the gearbox.	Mar. 2011	██████	██████	██████
2011-6	Replaced G1 bearings with SKF 6320-ZC3S1 bearings.	Due to thermal imaging scanning of plant, early failure of bearings was detected. Bearings were replaced before imminent failure, thus allowing increased production and reduced downtime. . Investment extended facilities useful life span by reducing the risk of system failure.	Nov. 2011	██████	██████	██████
2011-7	Modified transformer on high side with tygon tubing, to test oil levels. Replaced blown	Installation of new visual oil level sensor allows for additional monitoring of oil in transformer. Facility was shut down due to blown high voltage bushing in transformer, bushing was replaced and oil was renovated to enable plant operation. Refurbishment increased useful lifespan and avoided expensive replacement of transformer.	Nov. 2011	██████	██████	██████

¹ Plant was purchased in 2008 by Petitioner. A 27-year period indicates that the equipment was past its useful life, and that refurbishment replaced original equipment

	high voltage bushing and binary transformer					
2011-8	Replaced batteries and maintainer in DC HPU, spare inverter to keep backup of critical component available	Enabled plant to be safely shut down when grid power was down. This is a required emergency backup system. Without replacement of batteries and maintenance DC UPS 12V system facility cannot experience a controlled shutdown of the turbines during a loss of power.	Dec. 2011	██████	██████	██████
2011-9	Installed new check valves for HPU	Required refurbishment, original component had reached end of useful life expectancy.	Dec. 2011	██████	██████	██████
2011-10	Bought two-stage compressor.	Installed more reliable compressor to drive safety air valve for more reliable operation of critical system.	Dec. 2011	██████████	██████	██████
	Total Costs					██████

² “New piece of equipment”-indicates that the plant did not have this vital piece of equipment installed for reliable operation prior to 2011.

Hopkinton Hydro Project						
2012 Capital and Efficiency Improvements						
<u>No.</u>	<u>Description of Improvements</u>	<u>Description of Improvement Benefit</u>	<u>When Completed</u>	<u>Age at Time of Refurbishment</u>	<u>New Useful Life</u>	<u>Total Cost</u>
2012-1	Refurbished G2 capacitors to avoid shorting.	Complete overhaul of G2 capacitor bank to facilitate more robust connections. Previous capacitors continued to fail. Required for reliability of safety system. Replaced capacitors to maintain system stability and protection of generator from surges caused by instability in grid. Previous system was obsolete and damaged.	Apr. 2012	██████	██████	██████
2012-2	Replaced G2 bearing cover.	During annual inspection G2 bearing cover was found to be loose and wearing shaft. Cover was rebuilt repaired and reinforced to avoid future failures. Fixed G1 bearing cover to avoid same.	Jun. 2012	██████	██████	██████
2012-3	Installed dry transformer.	Upgraded and reconfigured powerhouse electrical system.	Jun. 2012	██████	██████	██████
2012-4	Replaced relay-G1 safety air valve.	Replaced relay and circuit control of critical component. Safety air valve was not functional but is required for safe plant operations. Required piece of equipment to maintain safety of plant by reducing torque on turbine during normal and emergency shutdown. Now included on normal shutdown to protect equipment.	Jun. 2012	██████	██████	██████
2012-5	Refurbished shaft.	Shaft on G2 turbine was weakened by loose bearing cover. Refurbished shaft.	Sept 2012	██████	██████	██████
2012-6	Refurbished dam.	Refurbished undermined foundation of dam and by placing 28 cubic yards of gunnite on dam.	July 2012	██████	██████	██████
	Total Costs					██████

¹ Plant was purchased in 2008 by Petitioner. A 28-year period indicates that the equipment was past its useful life, and that refurbishment replaced original equipment

² “New piece of equipment”-indicates that the plant did not have this vital piece of equipment installed for reliable operation prior to 2012.