



Maintenance Program

Code	Name	Station ID	Asset Description	Component	Failure Mode	Criticality	Failure Pattern	Task	Frequency	Done by	Comments
For dedicated spare pumps & motors only	Pump	NVL	Horizontal pump between bearings	Bearings	bearing failure caused by false brinelling	High	Age-related	Rotate pump shaft 2-1/4 times	Every shift	Operator	Ensure that pump is isolated from power source
For dedicated spare pumps & motors only	Pump	NVL	Horizontal pump between bearings	Bearings	Bearing failure caused by contaminated oil	High	Random	Inspect oil for water contamination Regrease as necessary	Weekly	Maintenance contractor	
For dedicated spare pumps & motors only	Motor	NVL	Horizontal pump between bearings	Starter; Auto start system	Fail to start	High	Random	Start pump and run for at least 2 hours. Check all functionalities.	Monthly	Operator	Do this during visit by maintenance contractor.
WSO-NVEPR-0002	R1 Inlet Motorized Actuator	NVL	Motorized valve	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0003	R1 Inlet Butterfly Valve 1	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0004	R1 Inlet Butterfly Valve 2	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0005	R2 Inlet Motorized Actuator 1	NVL	Motorized valve	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0006	R2 Inlet Butterfly Valve 1	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0007	R2 Inlet Butterfly Valve 2	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0008	R1 Outlet Butterfly Valve 1	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0009	R1 Outlet Butterfly Valve 2	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0010	R1 Outlet Butterfly Valve 3	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0011	R1 Outlet Butterfly Valve 4	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0012	R2 Outlet Butterfly Valve 1	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0013	R2 Outlet Butterfly Valve 2	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0014	R2 Outlet Butterfly Valve 3	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.



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WSO-NVEPR-0015	R2 Outlet Butterfly Valve 4	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0016	Main Suction Pipe	NVL	Piping	Flange	Leaks due to loose bolts and/or gasket failure	Medium	Age-related	Re-tighten bolts using specified torque values	Annually	Maintenance contractor	Use proper bolt tightening methods (e.g. manual, hydraulic, pneumatic, tensioning, etc.) Apply required bolt torque values.
WSO-NVEPR-0017	Suction Pipe and Fittings North A	NVL	Piping	Flange	Leaks due to loose bolts and/or gasket failure	Medium	Age-related	Re-tighten bolts using specified torque values	Annually	Maintenance contractor	Use proper bolt tightening methods (e.g. manual, hydraulic, pneumatic, tensioning, etc.) Apply required bolt torque values.
WSO-NVEPR-0018	Air valve North A	NVL	Air valve	Actuator	Fail Open/Fail Close	Medium	Random	Overhaul pneumatic actuator & clean internals	Annually	Maintenance contractor	Assign task to OEM contractor.
WSO-NVEPR-0019	Suction Pipe and Fittings North B	NVL	Piping	Flange	Leaks due to loose bolts and/or gasket failure	Medium	Age-related	Re-tighten bolts using specified torque values	Annually	Maintenance contractor	Use proper bolt tightening methods (e.g. manual, hydraulic, pneumatic, tensioning, etc.) Apply required bolt torque values.
WSO-NVEPR-0020	Air valve North B	NVL	Air valve	Actuator	Fail Open/Fail Close	Medium	Random	Overhaul pneumatic actuator & clean internals	Annually	Maintenance contractor	Assign task to OEM contractor.
WSO-NVEPR-0021	Suction Pipe and Fittings North C	NVL	Piping	Flange	Leaks due to loose bolts and/or gasket failure	Medium	Age-related	Re-tighten bolts using specified torque values	Annually	Maintenance contractor	Use proper bolt tightening methods (e.g. manual, hydraulic, pneumatic, tensioning, etc.) Apply required bolt torque values.
WSO-NVEPR-0022	Air valve North C	NVL	Air valve	Actuator	Fail Open/Fail Close	Medium	Random	Overhaul pneumatic actuator & clean internals	Annually	Maintenance contractor	Assign task to OEM contractor.
WSO-NVEPR-0023	Pipes and Fittings NA1	NVL	Piping	Flange	Leaks due to loose bolts and/or gasket failure	Medium	Age-related	Re-tighten bolts using specified torque values	Annually	Maintenance contractor	Use proper bolt tightening methods (e.g. manual, hydraulic, pneumatic, tensioning, etc.) Apply required bolt torque values.
WSO-NVEPR-0024	Suction Butterfly Valve NA1	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0025	Storage Pump NA1	NVL	Pump	Bearings	Loss of lubrication	High	Age-related	Scheduled greasing	Weekly	Maintenance contractor	Avoid overgreasing. Use correct grease as stipulated by bearing manufacturer.
WSO-NVEPR-0025	Storage Pump NA1	NVL	Pump	Bearings	High vibration due to cavitation	High	Random	Monitor suction pressure not to go below <u>xx</u> head.	Every hour	Operator	Refer to pump specifications on minimum NPSH requirements. Follow company policy in dealing with cavitation issues (e.g. call MCC to increase suction pressure and/or shutdown pumps)
WSO-NVEPR-0025	Storage Pump NA1	NVL	Pump	Bearings	High vibration due to bearing failure (e.g. foreign materials in lubrication)	High	Random	Vibration monitoring	2-weekly (every 2 weeks)	Maintenance contractor	Use trained contractor for the appropriate vibration monitoring device. Report findings every month.
WSO-NVEPR-0025	Storage Pump NA1	NVL	Pump	Packing	Excessive leaks	Medium	Age-related	Tighten packing bolts	2-weekly (every 2 weeks)	Maintenance contractor	Avoid overtightening of packing bolts.
WSO-NVEPR-0025	Storage Pump NA1	NVL	Pump	Flange	Leaks due to loose bolts and/or gasket failure	Medium	Age-related	Re-tighten bolts using specified torque values	Annually	Maintenance contractor	Use proper bolt tightening methods (e.g. manual, hydraulic, pneumatic, tensioning, etc.) Apply required bolt torque values.
WSO-NVEPR-0025	Storage Pump NA1	NVL	Pump	Vibration dampers	Leaks due to deteriorated materials caused by fatigue	Medium	Age-related	Replace vibration dampers based on recommended life	Every 10 years	Maintenance contractor	Refer to recommended life of dampers by manufacturer. Otherwise, purchase spare damper before its recommended life to ensure availability when needed.
WSO-NVEPR-0025	Storage Pump NA1	NVL	Pump	System	General system leaks	Low	Random	Inspect system for leaks	Shift	Operator	Report excessive leaks for scheduled repairs.



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WSO-NVEPR-0025	Storage Pump NA1	NVL	Pump	Impeller	Impeller wear	Low	Age-related	-Replace impeller -Inspect and measure clearances	-10 years -Annually	Maintenance contractor	Inspect during annual overhauls.
WSO-NVEPR-0025	Storage Pump NA1	NVL	Pump	Suction strainer	Blockage	Medium	Age-related	Clean strainer	Annually	Maintenance contractor	During annual overhauls.
WSO-NVEPR-0026	Check Valve NA1	NVL	Check valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0027	Discharge Motorized Actuator NA1	NVL	Motorized valve	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0028	Discharge Motorized Butterfly Valve NA1	NVL	Motorized valve	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0029	Discharge Butterfly Valve NA1	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0030	Storage Pump Motor NA1	NVL	Motor	Motor winding	Motor trip due to overloading	High	Random	Motor (skin) temperature measurement	Every hour	Operator	Refer to motor specifications on maximum allowable surface temperature.
WSO-NVEPR-0030	Storage Pump Motor NA1	NVL	Motor	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0031	Pipes and Fittings NA2	NVL	Piping	Flange	Leaks due to loose bolts and/or gasket failure	Medium	Age-related	Re-tighten bolts using specified torque values	Annually	Maintenance contractor	Use proper bolt tightening methods (e.g. manual, hydraulic, pneumatic, tensioning, etc.) Apply required bolt torque values.
WSO-NVEPR-0032	Suction Butterfly Valve NA2	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0033	Storage Pump NA2	NVL	Pump	Bearings	Loss of lubrication	High	Age-related	Scheduled greasing	Weekly	Maintenance contractor	Avoid overgreasing. Use correct grease as stipulated by bearing manufacturer.
WSO-NVEPR-0033	Storage Pump NA2	NVL	Pump	Bearings	High vibration due to cavitation	High	Random	Monitor suction pressure not to go below <u>xx</u> head.	Every hour	Operator	Refer to pump specifications on minimum NPSH requirements. Follow company policy in dealing with cavitation issues (e.g. call MCC to increase suction pressure and/or shutdown pumps)
WSO-NVEPR-0034	Storage Pump NA3	NVL	Pump	Bearings	High vibration due to bearing failure (e.g. foreign materials in lubrication)	High	Random	Vibration monitoring	2-weekly (every 2 weeks)	Maintenance contractor	Use trained contractor for the appropriate vibration monitoring device. Report findings every month.
WSO-NVEPR-0035	Storage Pump NA4	NVL	Pump	Packing	Excessive leaks	Medium	Age-related	Tighten packing bolts	2-weekly (every 2 weeks)	Maintenance contractor	Avoid overtightening of packing bolts.
WSO-NVEPR-0036	Storage Pump NA5	NVL	Pump	Flange	Leaks due to loose bolts and/or gasket failure	Medium	Age-related	Re-tighten bolts using specified torque values	Annually	Maintenance contractor	Use proper bolt tightening methods (e.g. manual, hydraulic, pneumatic, tensioning, etc.) Apply required bolt torque values.
WSO-NVEPR-0037	Storage Pump NA6	NVL	Pump	Vibration dampers	Leaks due to deteriorated materials caused by fatigue	Medium	Age-related	Replace vibration dampers based on recommended life	Every 10 years	Maintenance contractor	Refer to recommended life of dampers by manufacturer. Otherwise, purchase spare damper before its recommended life to ensure availability when needed.



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WSO-NVEPR-0038	Storage Pump NA7	NVL	Pump	System	General system leaks	Low	Random	Inspect system for leaks	Shift	Operator	Report excessive leaks for scheduled repairs.
WSO-NVEPR-0039	Storage Pump NA8	NVL	Pump	Impeller	Impeller wear	Low	Age-related	-Replace impeller -Inspect and measure clearances	-10 years -Annually	Maintenance contractor	Inspect during annual overhauls.
WSO-NVEPR-0040	Storage Pump NA9	NVL	Pump	Suction strainer	Blockage	Medium	Age-related	Clean strainer	Annually	Maintenance contractor	During annual overhauls.
WSO-NVEPR-0034	Check Valve NA2	NVL	Check valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0035	Discharge Motorized Actuator NA2	NVL	Motorized valve	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0036	Discharge Motorized Butterfly Valve NA2	NVL	Motorized valve	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0037	Discharge Butterfly Valve NA2	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0038	Storage Pump Motor NA2	NVL	Motor	Motor winding	Motor trip due to overloading	High	Random	Motor (skin) temperature measurement	Every hour	Operator	Refer to motor specifications on maximum allowable surface temperature.
WSO-NVEPR-0038	Storage Pump Motor NA2	NVL	Motor	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0039	Pipes and Fittings NA3	NVL	Piping	Flange	Leaks due to loose bolts and/or gasket failure	Medium	Age-related	Re-tighten bolts using specified torque values	Annually	Maintenance contractor	Use proper bolt tightening methods (e.g. manual, hydraulic, pneumatic, tensioning, etc.) Apply required bolt torque values.
WSO-NVEPR-0040	Suction Butterfly Valve NA3	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0041	Storage Pump NA3	NVL	Pump	Bearings	Loss of lubrication	High	Age-related	Scheduled greasing	Weekly	Maintenance contractor	Avoid overgreasing. Use correct grease as stipulated by bearing manufacturer.
WSO-NVEPR-0041	Storage Pump NA3	NVL	Pump	Bearings	High vibration due to cavitation	High	Random	Monitor suction pressure not to go below <u>xx</u> head.	Every hour	Operator	Refer to pump specifications on minimum NPSH requirements. Follow company policy in dealing with cavitation issues (e.g. call MCC to increase suction pressure and/or shutdown pumps)
WSO-NVEPR-0041	Storage Pump NA3	NVL	Pump	Bearings	High vibration due to bearing failure (e.g. foreign materials in lubrication)	High	Random	Vibration monitoring	2-weekly (every 2 weeks)	Maintenance contractor	Use trained contractor for the appropriate vibration monitoring device. Report findings every month.
WSO-NVEPR-0041	Storage Pump NA3	NVL	Pump	Packing	Excessive leaks	Medium	Age-related	Tighten packing bolts	2-weekly (every 2 weeks)	Maintenance contractor	Avoid overtightening of packing bolts.
WSO-NVEPR-0041	Storage Pump NA3	NVL	Pump	Flange	Leaks due to loose bolts and/or gasket failure	Medium	Age-related	Re-tighten bolts using specified torque values	Annually	Maintenance contractor	Use proper bolt tightening methods (e.g. manual, hydraulic, pneumatic, tensioning, etc.) Apply required bolt torque values.



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WSO-NVEPR-0041	Storage Pump NA3	NVL	Pump	Vibration dampers	Leaks due to deteriorated materials caused by fatigue	Medium	Age-related	Replace vibration dampers based on recommended life	Every 10 years	Maintenance contractor	Refer to recommended life of dampers by manufacturer. Otherwise, purchase spare damper before its recommended life to ensure availability when needed.
WSO-NVEPR-0041	Storage Pump NA3	NVL	Pump	System	General system leaks	Low	Random	Inspect system for leaks	Shift	Operator	Report excessive leaks for scheduled repairs.
WSO-NVEPR-0041	Storage Pump NA3	NVL	Pump	Impeller	Impeller wear	Low	Age-related	-Replace impeller -Inspect and measure clearances	-10 years -Annually	Maintenance contractor	Inspect during annual overhauls.
WSO-NVEPR-0041	Storage Pump NA3	NVL	Pump	Suction strainer	Blockage	Medium	Age-related	Clean strainer	Annually	Maintenance contractor	During annual overhauls.
WSO-NVEPR-0042	Check Valve NA3	NVL	Check valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0043	Discharge Motorized Actuator NA3	NVL	Motorized valve	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0044	Discharge Motorized Butterfly Valve NA3	NVL	Motorized valve	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0045	Discharge Butterfly Valve NA3	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0046	Storage Pump Motor NA3	NVL	Motor	Motor winding	Motor trip due to overloading	High	Random	Motor (skin) temperature measurement	Every hour	Operator	Refer to motor specifications on maximum allowable surface temperature.
		NVL	Motor	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0047	Pipes and Fittings NA4	NVL	Piping	Flange	Leaks due to loose bolts and/or gasket failure	Medium	Age-related	Re-tighten bolts using specified torque values	Annually	Maintenance contractor	Use proper bolt tightening methods (e.g. manual, hydraulic, pneumatic, tensioning, etc.) Apply required bolt torque values.
WSO-NVEPR-0048	Suction Butterfly Valve NA4	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0049	Storage Pump NA4	NVL	Pump	Bearings	Loss of lubrication	High	Age-related	Scheduled greasing	Weekly	Maintenance contractor	Avoid overgreasing. Use correct grease as stipulated by bearing manufacturer.
WSO-NVEPR-0049	Storage Pump NA4	NVL	Pump	Bearings	High vibration due to cavitation	High	Random	Monitor suction pressure not to go below xx head.	Every hour	Operator	Refer to pump specifications on minimum NPSH requirements. Follow company policy in dealing with cavitation issues (e.g. call MCC to increase suction pressure and/or shutdown pumps)
WSO-NVEPR-0049	Storage Pump NA4	NVL	Pump	Bearings	High vibration due to bearing failure (e.g. foreign materials in lubrication)	High	Random	Vibration monitoring	2-weekly (every 2 weeks)	Maintenance contractor	Use trained contractor for the appropriate vibration monitoring device. Report findings every month.
WSO-NVEPR-0049	Storage Pump NA4	NVL	Pump	Packing	Excessive leaks	Medium	Age-related	Tighten packing bolts	2-weekly (every 2 weeks)	Maintenance contractor	Avoid overtightening of packing bolts.



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WSO-NVEPR-0049	Storage Pump NA4	NVL	Pump	Flange	Leaks due to loose bolts and/or gasket failure	Medium	Age-related	Re-tighten bolts using specified torque values	Annually	Maintenance contractor	Use proper bolt tightening methods (e.g. manual, hydraulic, pneumatic, tensioning, etc.) Apply required bolt torque values.
WSO-NVEPR-0049	Storage Pump NA4	NVL	Pump	Vibration dampers	Leaks due to deteriorated materials caused by fatigue	Medium	Age-related	Replace vibration dampers based on recommended life	Every 10 years	Maintenance contractor	Refer to recommended life of dampers by manufacturer. Otherwise, purchase spare damper before its recommended life to ensure availability when needed.
WSO-NVEPR-0049	Storage Pump NA4	NVL	Pump	System	General system leaks	Low	Random	Inspect system for leaks	Shift	Operator	Report excessive leaks for scheduled repairs.
WSO-NVEPR-0049	Storage Pump NA4	NVL	Pump	Impeller	Impeller wear	Low	Age-related	-Replace impeller -Inspect and measure clearances	-10 years -Annually	Maintenance contractor	Inspect during annual overhauls.
WSO-NVEPR-0049	Storage Pump NA4	NVL	Pump	Suction strainer	Blockage	Medium	Age-related	Clean strainer	Annually	Maintenance contractor	During annual overhauls.
WSO-NVEPR-0050	Check Valve NA4	NVL	Check valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0051	Discharge Motorized Actuator NA4	NVL	Motorized valve	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0052	Discharge Motorized Butterfly Valve NA4	NVL	Motorized valve	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0053	Discharge Butterfly Valve NA4	NVL	Motorized valve	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0054	Storage Pump Motor NA4	NVL	Motor	Motor winding	Motor trip due to overloading	High	Random	Motor (skin) temperature measurement	Every hour	Operator	Refer to motor specifications on maximum allowable surface temperature.
WSO-NVEPR-0054	Storage Pump Motor NA4	NVL	Motor	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0055	Pipes and Fittings NA5	NVL	Piping	Flange	Leaks due to loose bolts and/or gasket failure	Medium	Age-related	Re-tighten bolts using specified torque values	Annually	Maintenance contractor	Use proper bolt tightening methods (e.g. manual, hydraulic, pneumatic, tensioning, etc.) Apply required bolt torque values.
WSO-NVEPR-0056	Suction Butterfly Valve NA5	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0057	Storage Pump NA5	NVL	Pump	Bearings	Loss of lubrication	High	Age-related	Scheduled greasing	Weekly	Maintenance contractor	Avoid overgreasing. Use correct grease as stipulated by bearing manufacturer.
WSO-NVEPR-0057	Storage Pump NA5	NVL	Pump	Bearings	High vibration due to cavitation	High	Random	Monitor suction pressure not to go below <u>xx</u> head.	Every hour	Operator	Refer to pump specifications on minimum NPSH requirements. Follow company policy in dealing with cavitation issues (e.g. call MCC to increase suction pressure and/or shutdown pumps)
WSO-NVEPR-0057	Storage Pump NA5	NVL	Pump	Bearings	High vibration due to bearing failure (e.g. foreign materials in lubrication)	High	Random	Vibration monitoring	2-weekly (every 2 weeks)	Maintenance contractor	Use trained contractor for the appropriate vibration monitoring device. Report findings every month.



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WSO-NVEPR-0057	Storage Pump NA5	NVL	Pump	Packing	Excessive leaks	Medium	Age-related	Tighten packing bolts	2-weekly (every 2 weeks)	Maintenance contractor	Avoid overtightening of packing bolts.
WSO-NVEPR-0057	Storage Pump NA5	NVL	Pump	Flange	Leaks due to loose bolts and/or gasket failure	Medium	Age-related	Re-tighten bolts using specified torque values	Annually	Maintenance contractor	Use proper bolt tightening methods (e.g. manual, hydraulic, pneumatic, tensioning, etc.) Apply required bolt torque values.
WSO-NVEPR-0057	Storage Pump NA5	NVL	Pump	Vibration dampers	Leaks due to deteriorated materials caused by fatigue	Medium	Age-related	Replace vibration dampers based on recommended life	Every 10 years	Maintenance contractor	Refer to recommended life of dampers by manufacturer. Otherwise, purchase spare damper before its recommended life to ensure availability when needed.
WSO-NVEPR-0057	Storage Pump NA5	NVL	Pump	System	General system leaks	Low	Random	Inspect system for leaks	Shift	Operator	Report excessive leaks for scheduled repairs.
WSO-NVEPR-0057	Storage Pump NA5	NVL	Pump	Impeller	Impeller wear	Low	Age-related	-Replace impeller -Inspect and measure clearances	-10 years -Annually	Maintenance contractor	Inspect during annual overhauls.
WSO-NVEPR-0057	Storage Pump NA5	NVL	Pump	Suction strainer	Blockage	Medium	Age-related	Clean strainer	Annually	Maintenance contractor	During annual overhauls.
WSO-NVEPR-0058	Check Valve NA5	NVL	Check valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0059	Discharge Motorized Actuator NA5	NVL	Motorized valve	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0060	Discharge Motorized Butterfly Valve NA5	NVL	Motorized valve	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0061	Discharge Butterfly Valve NA5	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0062	Storage Pump Motor NA5	NVL	Motor	Motor winding	Motor trip due to overloading	High	Random	Motor (skin) temperature measurement	Every hour	Operator	Refer to motor specifications on maximum allowable surface temperature.
		NVL	Motor	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0063	Pipes and Fittings NA6	NVL	Piping	Flange	Leaks due to loose bolts and/or gasket failure	Medium	Age-related	Re-tighten bolts using specified torque values	Annually	Maintenance contractor	Use proper bolt tightening methods (e.g. manual, hydraulic, pneumatic, tensioning, etc.) Apply required bolt torque values.
WSO-NVEPR-0064	Suction Butterfly Valve NA6	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0065	Storage Pump NA6	NVL	Pump	Bearings	Loss of lubrication	High	Age-related	Scheduled greasing	Weekly	Maintenance contractor	Avoid overgreasing. Use correct grease as stipulated by bearing manufacturer.
WSO-NVEPR-0066	Storage Pump NA7	NVL	Pump	Bearings	High vibration due to cavitation	High	Random	Monitor suction pressure not to go below <u>xx</u> head.	Every hour	Operator	Refer to pump specifications on minimum NPSH requirements. Follow company policy in dealing with cavitation issues (e.g. call MCC to increase suction pressure and/or shutdown pumps)



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WSO-NVEPR-0067	Storage Pump NA8	NVL	Pump	Bearings	High vibration due to bearing failure (e.g. foreign materials in lubrication)	High	Random	Vibration monitoring	2-weekly (every 2 weeks)	Maintenance contractor	Use trained contractor for the appropriate vibration monitoring device. Report findings every month.
WSO-NVEPR-0068	Storage Pump NA9	NVL	Pump	Packing	Excessive leaks	Medium	Age-related	Tighten packing bolts	2-weekly (every 2 weeks)	Maintenance contractor	Avoid overtightening of packing bolts.
WSO-NVEPR-0069	Storage Pump NA10	NVL	Pump	Flange	Leaks due to loose bolts and/or gasket failure	Medium	Age-related	Re-tighten bolts using specified torque values	Annually	Maintenance contractor	Use proper bolt tightening methods (e.g. manual, hydraulic, pneumatic, tensioning, etc.) Apply required bolt torque values.
WSO-NVEPR-0070	Storage Pump NA11	NVL	Pump	Vibration dampers	Leaks due to deteriorated materials caused by fatigue	Medium	Age-related	Replace vibration dampers based on recommended life	Every 10 years	Maintenance contractor	Refer to recommended life of dampers by manufacturer. Otherwise, purchase spare damper before its recommended life to ensure availability when needed.
WSO-NVEPR-0071	Storage Pump NA12	NVL	Pump	System	General system leaks	Low	Random	Inspect system for leaks	Shift	Operator	Report excessive leaks for scheduled repairs.
WSO-NVEPR-0072	Storage Pump NA13	NVL	Pump	Impeller	Impeller wear	Low	Age-related	-Replace impeller -Inspect and measure clearances	-10 years -Annually	Maintenance contractor	Inspect during annual overhauls.
WSO-NVEPR-0073	Storage Pump NA14	NVL	Pump	Suction strainer	Blockage	Medium	Age-related	Clean strainer	Annually	Maintenance contractor	During annual overhauls.
WSO-NVEPR-0066	Check Valve NA6	NVL	Check valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0067	Discharge Motorized Actuator NA6	NVL	Motorized valve	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0068	Discharge Motorized Butterfly Valve NA6	NVL	Motorized valve	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0069	Discharge Butterfly Valve NA6	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0070	Storage Pump Motor NA6	NVL	Motor	Motor winding	Motor trip due to overloading	High	Random	Motor (skin) temperature measurement	Every hour	Operator	Refer to motor specifications on maximum allowable surface temperature.
		NVL	Motor	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0071	Pipes and Fittings NB1	NVL	Piping	Flange	Leaks due to loose bolts and/or gasket failure	Medium	Age-related	Re-tighten bolts using specified torque values	Annually	Maintenance contractor	Use proper bolt tightening methods (e.g. manual, hydraulic, pneumatic, tensioning, etc.) Apply required bolt torque values.
WSO-NVEPR-0072	Suction Butterfly Valve NB1	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0073	Storage Pump NB1	NVL	Pump	Bearings	Loss of lubrication	High	Age-related	Scheduled greasing	Weekly	Maintenance contractor	Avoid overgreasing. Use correct grease as stipulated by bearing manufacturer.



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WSO-NVEPR-0073	Storage Pump NB1	NVL	Pump	Bearings	High vibration due to cavitation	High	Random	Monitor suction pressure not to go below xx head.	Every hour	Operator	Refer to pump specifications on minimum NPSH requirements. Follow company policy in dealing with cavitation issues (e.g. call MCC to increase suction pressure and/or shutdown pumps)
WSO-NVEPR-0073	Storage Pump NB1	NVL	Pump	Bearings	High vibration due to bearing failure (e.g. foreign materials in lubrication)	High	Random	Vibration monitoring	2-weekly (every 2 weeks)	Maintenance contractor	Use trained contractor for the appropriate vibration monitoring device. Report findings every month.
WSO-NVEPR-0073	Storage Pump NB1	NVL	Pump	Packing	Excessive leaks	Medium	Age-related	Tighten packing bolts	2-weekly (every 2 weeks)	Maintenance contractor	Avoid overtightening of packing bolts.
WSO-NVEPR-0073	Storage Pump NB1	NVL	Pump	Flange	Leaks due to loose bolts and/or gasket failure	Medium	Age-related	Re-tighten bolts using specified torque values	Annually	Maintenance contractor	Use proper bolt tightening methods (e.g. manual, hydraulic, pneumatic, tensioning, etc.) Apply required bolt torque values.
WSO-NVEPR-0073	Storage Pump NB1	NVL	Pump	Vibration dampers	Leaks due to deteriorated materials caused by fatigue	Medium	Age-related	Replace vibration dampers based on recommended life	Every 10 years	Maintenance contractor	Refer to recommended life of dampers by manufacturer. Otherwise, purchase spare damper before its recommended life to ensure availability when needed.
WSO-NVEPR-0073	Storage Pump NB1	NVL	Pump	System	General system leaks	Low	Random	Inspect system for leaks	Shift	Operator	Report excessive leaks for scheduled repairs.
WSO-NVEPR-0073	Storage Pump NB1	NVL	Pump	Impeller	Impeller wear	Low	Age-related	-Replace impeller -Inspect and measure clearances	-10 years -Annually	Maintenance contractor	Inspect during annual overhauls.
WSO-NVEPR-0073	Storage Pump NB1	NVL	Pump	Suction strainer	Blockage	Medium	Age-related	Clean strainer	Annually	Maintenance contractor	During annual overhauls.
WSO-NVEPR-0074	Check Valve NB1	NVL	Check valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0075	Discharge Motorized Actuator NB1	NVL	Motorized valve	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0076	Discharge Motorized Butterfly Valve NB1	NVL	Motorized valve	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0077	Discharge Butterfly Valve NB1	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0078	Storage Pump Motor NB1	NVL	Motor	Motor winding	Motor trip due to overloading	High	Random	Motor (skin) temperature measurement	Every hour	Operator	Refer to motor specifications on maximum allowable surface temperature.
WSO-NVEPR-0078	Storage Pump Motor NB1	NVL	Motor	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0079	Pipes and Fittings NB2	NVL	Piping	Flange	Leaks due to loose bolts and/or gasket failure	Medium	Age-related	Re-tighten bolts using specified torque values	Annually	Maintenance contractor	Use proper bolt tightening methods (e.g. manual, hydraulic, pneumatic, tensioning, etc.) Apply required bolt torque values.
WSO-NVEPR-0080	Suction Butterfly Valve NB2	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.



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WSO-NVEPR-0081	Storage Pump NB2	NVL	Pump	Bearings	Loss of lubrication	High	Age-related	Scheduled greasing	Weekly	Maintenance contractor	Avoid overgreasing. Use correct grease as stipulated by bearing manufacturer.
WSO-NVEPR-0081	Storage Pump NB2	NVL	Pump	Bearings	High vibration due to cavitation	High	Random	Monitor suction pressure not to go below <u>xx</u> head.	Every hour	Operator	Refer to pump specifications on minimum NPSH requirements. Follow company policy in dealing with cavitation issues (e.g. call MCC to increase suction pressure and/or shutdown pumps)
WSO-NVEPR-0081	Storage Pump NB2	NVL	Pump	Bearings	High vibration due to bearing failure (e.g. foreign materials in lubrication)	High	Random	Vibration monitoring	2-weekly (every 2 weeks)	Maintenance contractor	Use trained contractor for the appropriate vibration monitoring device. Report findings every month.
WSO-NVEPR-0081	Storage Pump NB2	NVL	Pump	Packing	Excessive leaks	Medium	Age-related	Tighten packing bolts	2-weekly (every 2 weeks)	Maintenance contractor	Avoid overtightening of packing bolts.
WSO-NVEPR-0081	Storage Pump NB2	NVL	Pump	Flange	Leaks due to loose bolts and/or gasket failure	Medium	Age-related	Re-tighten bolts using specified torque values	Annually	Maintenance contractor	Use proper bolt tightening methods (e.g. manual, hydraulic, pneumatic, tensioning, etc.) Apply required bolt torque values.
WSO-NVEPR-0081	Storage Pump NB2	NVL	Pump	Vibration dampers	Leaks due to deteriorated materials caused by fatigue	Medium	Age-related	Replace vibration dampers based on recommended life	Every 10 years	Maintenance contractor	Refer to recommended life of dampers by manufacturer. Otherwise, purchase spare damper before its recommended life to ensure availability when needed.
WSO-NVEPR-0081	Storage Pump NB2	NVL	Pump	System	General system leaks	Low	Random	Inspect system for leaks	Shift	Operator	Report excessive leaks for scheduled repairs.
WSO-NVEPR-0081	Storage Pump NB2	NVL	Pump	Impeller	Impeller wear	Low	Age-related	-Replace impeller -Inspect and measure clearances	-10 years -Annually	Maintenance contractor	Inspect during annual overhauls.
WSO-NVEPR-0081	Storage Pump NB2	NVL	Pump	Suction strainer	Blockage	Medium	Age-related	Clean strainer	Annually	Maintenance contractor	During annual overhauls.
WSO-NVEPR-0082	Check Valve NB2	NVL	Check valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0083	Discharge Motorized Actuator NB2	NVL	Motorized valve	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0084	Discharge Motorized Butterfly Valve NB2	NVL	Motorized valve	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0085	Discharge Butterfly Valve NB2	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0086	Storage Pump Motor NB2	NVL	Motor	Motor winding	Motor trip due to overloading	High	Random	Motor (skin) temperature measurement	Every hour	Operator	Refer to motor specifications on maximum allowable surface temperature.
WSO-NVEPR-0086	Storage Pump Motor NB2	NVL	Motor	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0087	Pipes and Fittings NB3	NVL	Piping	Flange	Leaks due to loose bolts and/or gasket failure	Medium	Age-related	Re-tighten bolts using specified torque values	Annually	Maintenance contractor	Use proper bolt tightening methods (e.g. manual, hydraulic, pneumatic, tensioning, etc.) Apply required bolt torque values.



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WSO-NVEPR-0088	Suction Butterfly Valve NB3	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0089	Storage Pump NB3	NVL	Pump	Bearings	Loss of lubrication	High	Age-related	Scheduled greasing	Weekly	Maintenance contractor	Avoid overgreasing. Use correct grease as stipulated by bearing manufacturer.
WSO-NVEPR-0089	Storage Pump NB3	NVL	Pump	Bearings	High vibration due to cavitation	High	Random	Monitor suction pressure not to go below <u>xx</u> head.	Every hour	Operator	Refer to pump specifications on minimum NPSH requirements. Follow company policy in dealing with cavitation issues (e.g. call MCC to increase suction pressure and/or shutdown pumps)
WSO-NVEPR-0089	Storage Pump NB3	NVL	Pump	Bearings	High vibration due to bearing failure (e.g. foreign materials in lubrication)	High	Random	Vibration monitoring	2-weekly (every 2 weeks)	Maintenance contractor	Use trained contractor for the appropriate vibration monitoring device. Report findings every month.
WSO-NVEPR-0089	Storage Pump NB3	NVL	Pump	Packing	Excessive leaks	Medium	Age-related	Tighten packing bolts	2-weekly (every 2 weeks)	Maintenance contractor	Avoid overtightening of packing bolts.
WSO-NVEPR-0089	Storage Pump NB3	NVL	Pump	Flange	Leaks due to loose bolts and/or gasket failure	Medium	Age-related	Re-tighten bolts using specified torque values	Annually	Maintenance contractor	Use proper bolt tightening methods (e.g. manual, hydraulic, pneumatic, tensioning, etc.) Apply required bolt torque values.
WSO-NVEPR-0089	Storage Pump NB3	NVL	Pump	Vibration dampers	Leaks due to deteriorated materials caused by fatigue	Medium	Age-related	Replace vibration dampers based on recommended life	Every 10 years	Maintenance contractor	Refer to recommended life of dampers by manufacturer. Otherwise, purchase spare damper before its recommended life to ensure availability when needed.
WSO-NVEPR-0089	Storage Pump NB3	NVL	Pump	System	General system leaks	Low	Random	Inspect system for leaks	Shift	Operator	Report excessive leaks for scheduled repairs.
WSO-NVEPR-0089	Storage Pump NB3	NVL	Pump	Impeller	Impeller wear	Low	Age-related	-Replace impeller -Inspect and measure clearances	-10 years -Annually	Maintenance contractor	Inspect during annual overhauls.
WSO-NVEPR-0089	Storage Pump NB3	NVL	Pump	Suction strainer	Blockage	Medium	Age-related	Clean strainer	Annually	Maintenance contractor	During annual overhauls.
WSO-NVEPR-0090	Check Valve NB3	NVL	Check valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0091	Discharge Motorized Actuator NB3	NVL	Motorized valve	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0092	Discharge Motorized Butterfly Valve NB3	NVL	Motorized valve	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0093	Discharge Butterfly Valve NB3	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0094	Storage Pump Motor NB3	NVL	Motor	Motor winding	Motor trip due to overloading	High	Random	Motor (skin) temperature measurement	Every hour	Operator	Refer to motor specifications on maximum allowable surface temperature.
WSO-NVEPR-0094	Storage Pump Motor NB3	NVL	Motor	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.



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WSO-NVEPR-0095	Pipes and Fittings NB4	NVL	Piping	Flange	Leaks due to loose bolts and/or gasket failure	Medium	Age-related	Re-tighten bolts using specified torque values	Annually	Maintenance contractor	Use proper bolt tightening methods (e.g. manual, hydraulic, pneumatic, tensioning, etc.) Apply required bolt torque values.
WSO-NVEPR-0096	Suction Butterfly Valve NB4	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0097	Storage Pump NB4	NVL	Pump	Bearings	Loss of lubrication	High	Age-related	Scheduled greasing	Weekly	Maintenance contractor	Avoid overgreasing. Use correct grease as stipulated by bearing manufacturer.
WSO-NVEPR-0097	Storage Pump NB4	NVL	Pump	Bearings	High vibration due to cavitation	High	Random	Monitor suction pressure not to go below <u>xx</u> head.	Every hour	Operator	Refer to pump specifications on minimum NPSH requirements. Follow company policy in dealing with cavitation issues (e.g. call MCC to increase suction pressure and/or shutdown pumps)
WSO-NVEPR-0097	Storage Pump NB4	NVL	Pump	Bearings	High vibration due to bearing failure (e.g. foreign materials in lubrication)	High	Random	Vibration monitoring	2-weekly (every 2 weeks)	Maintenance contractor	Use trained contractor for the appropriate vibration monitoring device. Report findings every month.
WSO-NVEPR-0097	Storage Pump NB4	NVL	Pump	Packing	Excessive leaks	Medium	Age-related	Tighten packing bolts	2-weekly (every 2 weeks)	Maintenance contractor	Avoid overtightening of packing bolts.
WSO-NVEPR-0097	Storage Pump NB4	NVL	Pump	Flange	Leaks due to loose bolts and/or gasket failure	Medium	Age-related	Re-tighten bolts using specified torque values	Annually	Maintenance contractor	Use proper bolt tightening methods (e.g. manual, hydraulic, pneumatic, tensioning, etc.) Apply required bolt torque values.
WSO-NVEPR-0097	Storage Pump NB4	NVL	Pump	Vibration dampers	Leaks due to deteriorated materials caused by fatigue	Medium	Age-related	Replace vibration dampers based on recommended life	Every 10 years	Maintenance contractor	Refer to recommended life of dampers by manufacturer. Otherwise, purchase spare damper before its recommended life to ensure availability when needed.
WSO-NVEPR-0097	Storage Pump NB4	NVL	Pump	System	General system leaks	Low	Random	Inspect system for leaks	Shift	Operator	Report excessive leaks for scheduled repairs.
WSO-NVEPR-0097	Storage Pump NB4	NVL	Pump	Impeller	Impeller wear	Low	Age-related	-Replace impeller -Inspect and measure clearances	-10 years -Annually	Maintenance contractor	Inspect during annual overhauls.
WSO-NVEPR-0097	Storage Pump NB4	NVL	Pump	Suction strainer	Blockage	Medium	Age-related	Clean strainer	Annually	Maintenance contractor	During annual overhauls.
WSO-NVEPR-0098	Check Valve NB4	NVL	Check valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0099	Discharge Motorized Actuator NB4	NVL	Motorized valve	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0100	Discharge Motorized Butterfly Valve NB4	NVL	Motorized valve	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0101	Discharge Butterfly Valve NB4	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0102	Storage Pump Motor NB4	NVL	Motor	Motor winding	Motor trip due to overloading	High	Random	Motor (skin) temperature measurement	Every hour	Operator	Refer to motor specifications on maximum allowable surface temperature.



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WSO-NVEPR-0102	Storage Pump Motor NB4	NVL	Motor	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0103	Pipes and Fittings NB5	NVL	Piping	Flange	Leaks due to loose bolts and/or gasket failure	Medium	Age-related	Re-tighten bolts using specified torque values	Annually	Maintenance contractor	Use proper bolt tightening methods (e.g. manual, hydraulic, pneumatic, tensioning, etc.) Apply required bolt torque values.
WSO-NVEPR-0104	Suction Butterfly Valve NB5	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0105	Storage Pump NB5	NVL	Pump	Bearings	Loss of lubrication	High	Age-related	Scheduled greasing	Weekly	Maintenance contractor	Avoid overgreasing. Use correct grease as stipulated by bearing manufacturer.
WSO-NVEPR-0105	Storage Pump NB5	NVL	Pump	Bearings	High vibration due to cavitation	High	Random	Monitor suction pressure not to go below <u>xx</u> head.	Every hour	Operator	Refer to pump specifications on minimum NPSH requirements. Follow company policy in dealing with cavitation issues (e.g. call MCC to increase suction pressure and/or shutdown pumps)
WSO-NVEPR-0105	Storage Pump NB5	NVL	Pump	Bearings	High vibration due to bearing failure (e.g. foreign materials in lubrication)	High	Random	Vibration monitoring	2-weekly (every 2 weeks)	Maintenance contractor	Use trained contractor for the appropriate vibration monitoring device. Report findings every month.
WSO-NVEPR-0105	Storage Pump NB5	NVL	Pump	Packing	Excessive leaks	Medium	Age-related	Tighten packing bolts	2-weekly (every 2 weeks)	Maintenance contractor	Avoid overtightening of packing bolts.
WSO-NVEPR-0105	Storage Pump NB5	NVL	Pump	Flange	Leaks due to loose bolts and/or gasket failure	Medium	Age-related	Re-tighten bolts using specified torque values	Annually	Maintenance contractor	Use proper bolt tightening methods (e.g. manual, hydraulic, pneumatic, tensioning, etc.) Apply required bolt torque values.
WSO-NVEPR-0105	Storage Pump NB5	NVL	Pump	Vibration dampers	Leaks due to deteriorated materials caused by fatigue	Medium	Age-related	Replace vibration dampers based on recommended life	Every 10 years	Maintenance contractor	Refer to recommended life of dampers by manufacturer. Otherwise, purchase spare damper before its recommended life to ensure availability when needed.
WSO-NVEPR-0105	Storage Pump NB5	NVL	Pump	System	General system leaks	Low	Random	Inspect system for leaks	Shift	Operator	Report excessive leaks for scheduled repairs.
WSO-NVEPR-0105	Storage Pump NB5	NVL	Pump	Impeller	Impeller wear	Low	Age-related	-Replace impeller -Inspect and measure clearances	-10 years -Annually	Maintenance contractor	Inspect during annual overhauls.
WSO-NVEPR-0105	Storage Pump NB5	NVL	Pump	Suction strainer	Blockage	Medium	Age-related	Clean strainer	Annually	Maintenance contractor	During annual overhauls.
WSO-NVEPR-0106	Check Valve NB5	NVL	Check valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0107	Discharge Motorized Actuator NB5	NVL	Motorized valve	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0108	Discharge Motorized Butterfly Valve NB5	NVL	Motorized valve	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0109	Discharge Butterfly Valve NB5	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.



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WSO-NVEPR-0110	Storage Pump Motor NB5	NVL	Motor	Motor winding	Motor trip due to overloading	High	Random	Motor (skin) temperature measurement	Every hour	Operator	Refer to motor specifications on maximum allowable surface temperature.
WSO-NVEPR-0110	Storage Pump Motor NB5	NVL	Motor	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0111	Pipes and Fittings NC1	NVL	Piping	Flange	Leaks due to loose bolts and/or gasket failure	Medium	Age-related	Re-tighten bolts using specified torque values	Annually	Maintenance contractor	Use proper bolt tightening methods (e.g. manual, hydraulic, pneumatic, tensioning, etc.) Apply required bolt torque values.
WSO-NVEPR-0112	Suction Butterfly Valve NC1	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0113	Storage Pump NC1	NVL	Pump	Bearings	Loss of lubrication	High	Age-related	Scheduled greasing	Weekly	Maintenance contractor	Avoid overgreasing. Use correct grease as stipulated by bearing manufacturer.
WSO-NVEPR-0113	Storage Pump NC1	NVL	Pump	Bearings	High vibration due to cavitation	High	Random	Monitor suction pressure not to go below <u>xx</u> head.	Every hour	Operator	Refer to pump specifications on minimum NPSH requirements. Follow company policy in dealing with cavitation issues (e.g. call MCC to increase suction pressure and/or shutdown pumps)
WSO-NVEPR-0113	Storage Pump NC1	NVL	Pump	Bearings	High vibration due to bearing failure (e.g. foreign materials in lubrication)	High	Random	Vibration monitoring	2-weekly (every 2 weeks)	Maintenance contractor	Use trained contractor for the appropriate vibration monitoring device. Report findings every month.
WSO-NVEPR-0113	Storage Pump NC1	NVL	Pump	Packing	Excessive leaks	Medium	Age-related	Tighten packing bolts	2-weekly (every 2 weeks)	Maintenance contractor	Avoid overtightening of packing bolts.
WSO-NVEPR-0113	Storage Pump NC1	NVL	Pump	Flange	Leaks due to loose bolts and/or gasket failure	Medium	Age-related	Re-tighten bolts using specified torque values	Annually	Maintenance contractor	Use proper bolt tightening methods (e.g. manual, hydraulic, pneumatic, tensioning, etc.) Apply required bolt torque values.
WSO-NVEPR-0113	Storage Pump NC1	NVL	Pump	Vibration dampers	Leaks due to deteriorated materials caused by fatigue	Medium	Age-related	Replace vibration dampers based on recommended life	Every 10 years	Maintenance contractor	Refer to recommended life of dampers by manufacturer. Otherwise, purchase spare damper before its recommended life to ensure availability when needed.
WSO-NVEPR-0113	Storage Pump NC1	NVL	Pump	System	General system leaks	Low	Random	Inspect system for leaks	Shift	Operator	Report excessive leaks for scheduled repairs.
WSO-NVEPR-0113	Storage Pump NC1	NVL	Pump	Impeller	Impeller wear	Low	Age-related	-Replace impeller -Inspect and measure clearances	-10 years -Annually	Maintenance contractor	Inspect during annual overhauls.
WSO-NVEPR-0113	Storage Pump NC1	NVL	Pump	Suction strainer	Blockage	Medium	Age-related	Clean strainer	Annually	Maintenance contractor	During annual overhauls.
WSO-NVEPR-0114	Check Valve NC1	NVL	Check valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0115	Discharge Motorized Actuator NC1	NVL	Motorized valve	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0116	Discharge Motorized Butterfly Valve NC1	NVL	Motorized valve	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.



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WSO-NVEPR-0117	Discharge Butterfly Valve NC1	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0118	Storage Pump Motor NC1	NVL	Motor	Motor winding	Motor trip due to overloading	High	Random	Motor (skin) temperature measurement	Every hour	Operator	Refer to motor specifications on maximum allowable surface temperature.
WSO-NVEPR-0118	Storage Pump Motor NC1	NVL	Motor	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0119	Pipes and Fittings NC2	NVL	Piping	Flange	Leaks due to loose bolts and/or gasket failure	Medium	Age-related	Re-tighten bolts using specified torque values	Annually	Maintenance contractor	Use proper bolt tightening methods (e.g. manual, hydraulic, pneumatic, tensioning, etc.) Apply required bolt torque values.
WSO-NVEPR-0120	Suction Butterfly Valve NC2	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0121	Storage Pump NC2	NVL	Pump	Bearings	Loss of lubrication	High	Age-related	Scheduled greasing	Weekly	Maintenance contractor	Avoid overgreasing. Use correct grease as stipulated by bearing manufacturer.
WSO-NVEPR-0121	Storage Pump NC2	NVL	Pump	Bearings	High vibration due to cavitation	High	Random	Monitor suction pressure not to go below <u>xx</u> head.	Every hour	Operator	Refer to pump specifications on minimum NPSH requirements. Follow company policy in dealing with cavitation issues (e.g. call MCC to increase suction pressure and/or shutdown pumps)
WSO-NVEPR-0121	Storage Pump NC2	NVL	Pump	Bearings	High vibration due to bearing failure (e.g. foreign materials in lubrication)	High	Random	Vibration monitoring	2-weekly (every 2 weeks)	Maintenance contractor	Use trained contractor for the appropriate vibration monitoring device. Report findings every month.
WSO-NVEPR-0121	Storage Pump NC2	NVL	Pump	Packing	Excessive leaks	Medium	Age-related	Tighten packing bolts	2-weekly (every 2 weeks)	Maintenance contractor	Avoid overtightening of packing bolts.
WSO-NVEPR-0121	Storage Pump NC2	NVL	Pump	Flange	Leaks due to loose bolts and/or gasket failure	Medium	Age-related	Re-tighten bolts using specified torque values	Annually	Maintenance contractor	Use proper bolt tightening methods (e.g. manual, hydraulic, pneumatic, tensioning, etc.) Apply required bolt torque values.
WSO-NVEPR-0121	Storage Pump NC2	NVL	Pump	Vibration dampers	Leaks due to deteriorated materials caused by fatigue	Medium	Age-related	Replace vibration dampers based on recommended life	Every 10 years	Maintenance contractor	Refer to recommended life of dampers by manufacturer. Otherwise, purchase spare damper before its recommended life to ensure availability when needed.
WSO-NVEPR-0121	Storage Pump NC2	NVL	Pump	System	General system leaks	Low	Random	Inspect system for leaks	Shift	Operator	Report excessive leaks for scheduled repairs.
WSO-NVEPR-0121	Storage Pump NC2	NVL	Pump	Impeller	Impeller wear	Low	Age-related	-Replace impeller -Inspect and measure clearances	-10 years -Annually	Maintenance contractor	Inspect during annual overhauls.
WSO-NVEPR-0121	Storage Pump NC2	NVL	Pump	Suction strainer	Blockage	Medium	Age-related	Clean strainer	Annually	Maintenance contractor	During annual overhauls.
WSO-NVEPR-0122	Check Valve NC2	NVL	Check valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0123	Discharge Motorized Actuator NC2	NVL	Motorized valve	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.



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WSO-NVEPR-0124	Discharge Motorized Butterfly Valve NC2	NVL	Motorized valve	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0125	Discharge Butterfly Valve NC2	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0126	Storage Pump Motor NC2	NVL	Motor	Motor winding	Motor trip due to overloading	High	Random	Motor (skin) temperature measurement	Every hour	Operator	Refer to motor specifications on maximum allowable surface temperature.
WSO-NVEPR-0126	Storage Pump Motor NC2	NVL	Motor	Motor winding	Motor burns due to failure of winding insulation	Low	Age-related	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-NVEPR-0127	Pipes and Fittings NC3	NVL	Piping	Flange	Leaks due to loose bolts and/or gasket failure	Medium	Age-related	Re-tighten bolts using specified torque values	Annually	Maintenance contractor	Use proper bolt tightening methods (e.g. manual, hydraulic, pneumatic, tensioning, etc.) Apply required bolt torque values.
WSO-NVEPR-0128	Suction Butterfly Valve NC3	NVL	Valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.
WSO-NVEPR-0129	Storage Pump NC3	NVL	Pump	Bearings	Loss of lubrication	High	Age-related	Scheduled greasing	Weekly	Maintenance contractor	Avoid overgreasing. Use correct grease as stipulated by bearing manufacturer.
WSO-NVEPR-0129	Storage Pump NC3	NVL	Pump	Bearings	High vibration due to cavitation	High	Random	Monitor suction pressure not to go below <u>xx</u> head.	Every hour	Operator	Refer to pump specifications on minimum NPSH requirements. Follow company policy in dealing with cavitation issues (e.g. call MCC to increase suction pressure and/or shutdown pumps)
WSO-NVEPR-0129	Storage Pump NC3	NVL	Pump	Bearings	High vibration due to bearing failure (e.g. foreign materials in lubrication)	High	Random	Vibration monitoring	2-weekly (every 2 weeks)	Maintenance contractor	Use trained contractor for the appropriate vibration monitoring device. Report findings every month.
WSO-NVEPR-0129	Storage Pump NC3	NVL	Pump	Packing	Excessive leaks	Medium	Age-related	Tighten packing bolts	2-weekly (every 2 weeks)	Maintenance contractor	Avoid overtightening of packing bolts.
WSO-NVEPR-0129	Storage Pump NC3	NVL	Pump	Flange	Leaks due to loose bolts and/or gasket failure	Medium	Age-related	Re-tighten bolts using specified torque values	Annually	Maintenance contractor	Use proper bolt tightening methods (e.g. manual, hydraulic, pneumatic, tensioning, etc.) Apply required bolt torque values.
WSO-NVEPR-0129	Storage Pump NC3	NVL	Pump	Vibration dampers	Leaks due to deteriorated materials caused by fatigue	Medium	Age-related	Replace vibration dampers based on recommended life	Every 10 years	Maintenance contractor	Refer to recommended life of dampers by manufacturer. Otherwise, purchase spare damper before its recommended life to ensure availability when needed.
WSO-NVEPR-0129	Storage Pump NC3	NVL	Pump	System	General system leaks	Low	Random	Inspect system for leaks	Shift	Operator	Report excessive leaks for scheduled repairs.
WSO-NVEPR-0129	Storage Pump NC3	NVL	Pump	Impeller	Impeller wear	Low	Age-related	-Replace impeller -Inspect and measure clearances	-10 years -Annually	Maintenance contractor	Inspect during annual overhauls.
WSO-NVEPR-0129	Storage Pump NC3	NVL	Pump	Suction strainer	Blockage	Medium	Age-related	Clean strainer	Annually	Maintenance contractor	During annual overhauls.
WSO-NVEPR-0130	Check Valve NC3	NVL	Check valve	Valve disc & seat	Valve passing (leaks)	Medium	Age-related	Test valve integrity	Annually	Maintenance contractor	Use qualified maintenance contractor. Failure of this valve may cause problems during maintenance of pump/motor.