



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	R1P	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	R1P	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	R1P	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-AR1PR-0014	Air Valve SP1	R1P	Air valve	Actuator	Fail Open/Fail Close	Medium	Random	Overhaul pneumatic actuator & clean internals	Annually	Maintenance contractor	Assign task to OEM contractor.
WSO-AR1PR-0024	Air Valve SP2	R1P	Air valve	Actuator	Fail Open/Fail Close	Medium	Random	Overhaul pneumatic actuator & clean internals	Annually	Maintenance contractor	Assign task to OEM contractor.
WSO-AR1PR-0034	Air Valve SP3	R1P	Air valve	Actuator	Fail Open/Fail Close	Medium	Random	Overhaul pneumatic actuator & clean internals	Annually	Maintenance contractor	Assign task to OEM contractor.
WSO-AR1PR-0042	Bypass Valve	R1P	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-AR1PR-0013	Check Valve SP1	R1P	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-AR1PR-0023	Check Valve SP2	R1P	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-AR1PR-0033	Check Valve SP3	R1P	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-AR1PR-0038	Discharge Pipe and Fittings	R1P	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-AR1PR-0012	Discharge Pressure Gauge SP1	R1P	Pressure Measuring	Bourdon tube	Pressure gauge reading is wrong due to wear	Low	Age-related	Replace pressure gauge	Annually	Maintenance contractor	Replace with calibrated pressure gauge. Mark with acceptable operating range. Criticality is low if the online pressure sensors are still functioning properly.
WSO-AR1PR-0022	Discharge Pressure Gauge SP2	R1P	Pressure Measuring	Bourdon tube	Pressure gauge reading is wrong due to wear	Low	Age-related	Replace pressure gauge	Annually	Maintenance contractor	Replace with calibrated pressure gauge. Mark with acceptable operating range. Criticality is low if the online pressure sensors are still functioning properly.
WSO-AR1PR-0032	Discharge Pressure Gauge SP3	R1P	Pressure Measuring	Bourdon tube	Pressure gauge reading is wrong due to wear	Low	Age-related	Replace pressure gauge	Annually	Maintenance contractor	Replace with calibrated pressure gauge. Mark with acceptable operating range. Criticality is low if the online pressure sensors are still functioning properly.
WSO-AR1PR-0041	Downstream SAV1 BV	R1P	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-AR1PR-0071	Fuel Day Tank	R1P	Tank	Tank wall & bottom	Leaks due to corrosion	High	Age-related	Inspect tank for leaks	Daily	Operator	Anytime during day shift.
WSO-AR1PR-0071	Fuel Day Tank	R1P	Tank	Tank wall & bottom	Leaks due to corrosion	High	Age-related	Clean tank & inspect bottom plates for corrosion	Every 2 years	Maintenance contractor	Use qualified maintenance contractor.



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WSO-AR1PR-0070	Fuel Storage Tank	R1P	Tank	Tank wall & bottom	Leaks due to corrosion	High	Age-related	Inspect tank for leaks	Daily	Operator	Anytime during day shift.
WSO-AR1PR-0070	Fuel Storage Tank	R1P	Tank	Tank wall & bottom	Leaks due to corrosion	High	Age-related	Clean tank & inspect bottom plates for corrosion	Every 2 years	Maintenance contractor	Use qualified maintenance contractor.
WSO-AR1PR-0003	Motorized Actuator BV1	R1P	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-AR1PR-0005	Motorized Actuator BV2	R1P	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-AR1PR-0016	Motorized Actuator SP1	R1P	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-AR1PR-0026	Motorized Actuator SP2	R1P	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-AR1PR-0036	Motorized Actuator SP3	R1P	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-AR1PR-0002	Motorized Discharge Valve BV1	R1P	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-AR1PR-0004	Motorized Discharge Valve BV2	R1P	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-AR1PR-0015	Motorized Discharge Valve SP1	R1P	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-AR1PR-0025	Motorized Discharge Valve SP2	R1P	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-AR1PR-0035	Motorized Discharge Valve SP3	R1P	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-AR1PR-0073	Overhead Travelling Crane	R1P	Lifting	Chain & gear mechanism	Failure of manual chain hoist due to wear & tear	High	Age-related	Inspect manual chain hoist for wear	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-AR1PR-0073	Overhead Travelling Crane	R1P	Lifting	Motor drive	Motor burns due to failure of winding insulation	High	Random	Inspect motor winding insulation	Annually	Maintenance contractor	Use qualified maintenance contractor.
WSO-AR1PR-0072	Pipes and Fittings for Fuel	R1P	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-AR1PR-0007	Reservoir Blow-off Butterfly Valve	R1P	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-AR1PR-0010	Storage Pump 1	R1P	Pumping	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-AR1PR-0010	Storage Pump 1	R1P	Pumping	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-AR1PR-0010	Storage Pump 1	R1P	Pumping	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-AR1PR-0010	Storage Pump 1	R1P	Pumping	Packing	Excessive leaks	Medium	Age-related	Tighten packing bolts	2-weekly (every 2 weeks)	Maintenance contractor	Avoid overtightening of packing bolts.
WSO-AR1PR-0010	Storage Pump 1	R1P	Pumping	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-AR1PR-0010	Storage Pump 1	R1P	Pumping	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-AR1PR-0010	Storage Pump 1	R1P	Pumping	System	General system leaks	Low	Random	Inspect system for leaks	Shift	Operator	Report excessive leaks for scheduled repairs.
WSO-AR1PR-0010	Storage Pump 1	R1P	Pumping	Impeller	Impeller wear	Low	Age-related	-Replace impeller -Inspect and measure clearances	-10 years -Annually	Maintenance contractor	Inspect during annual overhauls.
WSO-AR1PR-0010	Storage Pump 1	R1P	Pumping	Suction strainer	Blockage	Medium	Age-related	Clean strainer	Annually	Maintenance contractor	During annual overhauls.
WSO-AR1PR-0020	Storage Pump 2	R1P	Pumping	Bearings	Loss of lubrication	High	Age-related	Scheduled greasing	Weekly	Maintenance contractor	Avoid overgreasing. Use correct grease as stipulated by bearing manufacturer.
WSO-AR1PR-0020	Storage Pump 2	R1P	Pumping	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-AR1PR-0020	Storage Pump 2	R1P	Pumping	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-AR1PR-0020	Storage Pump 2	R1P	Pumping	Packing	Excessive leaks	Medium	Age-related	Tighten packing bolts	2-weekly (every 2 weeks)	Maintenance contractor	Avoid overtightening of packing bolts.
WSO-AR1PR-0020	Storage Pump 2	R1P	Pumping	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-AR1PR-0020	Storage Pump 2	R1P	Pumping	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-AR1PR-0020	Storage Pump 2	R1P	Pumping	System	General system leaks	Low	Random	Inspect system for leaks	Shift	Operator	Report excessive leaks for scheduled repairs.



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WSO-AR1PR-0020	Storage Pump 2	R1P	Pumping	Impeller	Impeller wear	Low	Age-related	-Replace impeller -Inspect and measure clearances	-10 years -Annually	Maintenance contractor	Inspect during annual overhauls.
WSO-AR1PR-0020	Storage Pump 2	R1P	Pumping	Suction strainer	Blockage	Medium	Age-related	Clean strainer	Annually	Maintenance contractor	During annual overhauls.
WSO-AR1PR-0030	Storage Pump 3	R1P	Pumping	Bearings	Loss of lubrication	High	Age-related	Scheduled greasing	Weekly	Maintenance contractor	Avoid overgreasing. Use correct grease as stipulated by bearing manufacturer.
WSO-AR1PR-0030	Storage Pump 3	R1P	Pumping	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-AR1PR-0030	Storage Pump 3	R1P	Pumping	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-AR1PR-0030	Storage Pump 3	R1P	Pumping	Packing	Excessive leaks	Medium	Age-related	Tighten packing bolts	2-weekly (every 2 weeks)	Maintenance contractor	Avoid overtightening of packing bolts.
WSO-AR1PR-0030	Storage Pump 3	R1P	Pumping	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-AR1PR-0030	Storage Pump 3	R1P	Pumping	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-AR1PR-0030	Storage Pump 3	R1P	Pumping	System	General system leaks	Low	Random	Inspect system for leaks	Shift	Operator	Report excessive leaks for scheduled repairs.
WSO-AR1PR-0030	Storage Pump 3	R1P	Pumping	Impeller	Impeller wear	Low	Age-related	-Replace impeller -Inspect and measure clearances	-10 years -Annually	Maintenance contractor	Inspect during annual overhauls.
WSO-AR1PR-0030	Storage Pump 3	R1P	Pumping	Suction strainer	Blockage	Medium	Age-related	Clean strainer	Annually	Maintenance contractor	During annual overhauls.
WSO-AR1PR-0017	Storage Pump Motor SP1	R1P	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-AR1PR-0017	Storage Pump Motor SP1	R1P	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-AR1PR-0027	Storage Pump Motor SP2	R1P	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-AR1PR-0027	Storage Pump Motor SP2	R1P	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-AR1PR-0037	Storage Pump Motor SP3	R1P	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-AR1PR-0037	Storage Pump Motor SP3	R1P	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-AR1PR-0009	Suction Butterfly Valve SP1	R1P	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-AR1PR-0019	Suction Butterfly Valve SP2	R1P	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-AR1PR-0029	Suction Butterfly Valve SP3	R1P	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-AR1PR-0001	Suction Pipes and Fittings	R1P	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-AR1PR-0008	Suction Pipes and Fittings SP1	R1P	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-AR1PR-0018	Suction Pipes and Fittings SP2	R1P	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-AR1PR-0028	Suction Pipes and Fittings SP3	R1P	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-AR1PR-0011	Suction Pressure Gauge SP1	R1P	Pressure Measuring	Bourdon tube	Pressure gauge reading is wrong due to wear	Low	Age-related	Replace pressure gauge	Annually	Maintenance contractor	Replace with calibrated pressure gauge. Mark with acceptable operating range. Criticality is low if the online pressure sensors are still functioning properly.
WSO-AR1PR-0021	Suction Pressure Gauge SP2	R1P	Pressure Measuring	Bourdon tube	Pressure gauge reading is wrong due to wear	Low	Age-related	Replace pressure gauge	Annually	Maintenance contractor	Replace with calibrated pressure gauge. Mark with acceptable operating range. Criticality is low if the online pressure sensors are still functioning properly.
WSO-AR1PR-0031	Suction Pressure Gauge SP3	R1P	Pressure Measuring	Bourdon tube	Pressure gauge reading is wrong due to wear	Low	Age-related	Replace pressure gauge	Annually	Maintenance contractor	Replace with calibrated pressure gauge. Mark with acceptable operating range. Criticality is low if the online pressure sensors are still functioning properly.
WSO-AR1PR-0040	Surge Anticipating Valve 1 (SAV1)	R1P	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-AR1PR-0039	Upstream SAV1 BV	R1P	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.