Attachment V

Operation and Maintenance Plan

1.6 MAINTENANCE SCHEDULE

Maintenance of the engine and control equipment is required at established intervals. The recommended intervals are for nominal environmental and operating conditions. Severe environments and extreme conditions may require more frequent and extensive maintenance. The local environment, operating conditions and practices, and the availability of skilled technicians must be carefully considered in establishing a maintenance plan. Preventive maintenance at specific intervals minimizes corrective maintenance.

⚠ WARNING

Prior to performing maintenance review safety procedures and follow safe lockout and tagout procedures.

If operational or service needs do not require the presence of service personnel in areas immediately adjacent to high speed rotating turbomachinery, personnel should avoid lingering in these areas during operation.

1.6.1 Daily and Monthly Maintenance

Daily and monthly maintenance includes a walkaround inspection to ensure equipment is functioning properly and to detect leaks or obvious faults.

Operating parameters should be recorded and analyzed for trends. This will help predict faults.

1.6.2 Semiannual Maintenance

Semiannual maintenance emphasizes protective systems checkout and ensures optimum equipment performance. Regardless of hours of operation, this maintenance should be performed semiannually.

Semiannual maintenance requires equipment shutdown.

1.6.3 Annual Maintenance

Annual maintenance involves disassembly of subsystem components for inspection. Problems noted in previous inspections should receive attention in annual maintenance whether or not they are listed in this manual. Detailed records help pinpoint malfunctions prior to performance impact.

For annual maintenance, equipment must be shut down.

1.6.4 Special Maintenance (if package has a Gear Unit)

Special maintenance is required for the gear unit. The gear unit requires disassembly, gear contact pattern and bearing inspection after 30 000 hours of operation.

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1.6.5 Scheduled Periodic Checks and Maintenance Tasks

Following tables (1.6.1 through 1.6.11) recommend general minimum maintenance intervals. Where Supplementary Data specify more frequent, or more extensive maintenance, or where operating conditions dictate, adhere to the more rigorous requirement.

- D (day)
- M (month)
- S (semiannual - 4000 operating hours)
- A (annual - 8000 operating hours)

Table 1.6.1 Maintenance - Electrical and Control Systems

System/Description	D	M	S	A
Periodic Checks				
Visually inspect gages and indicators for proper operation.	X			
Inspect control console electrical connections for cleanliness and security. Check wiring for absence of chafing and insulation damage.[1]		X		
If applicable, check fire detectors for sensitivity.[1]			X	
If applicable, clean fire detectors.[1]		X		
If applicable, check fire bottles for proper charge.			X	
Check battery charger for proper operation. For NiCad batteries, place charger to high rate for a few hours.[2]		X		
Check and record speed magnetic pickup output voltage. This must be done with engine running.			X	
Check condition of thermocouple harnesses. Check integrity of support grommets.[1]			X	
Periodic Maintenance Tasks				
Remove and inspect igniter cable. Inspect igniter plug for erosion and proper gap. Replace plug if necessary.			X	
Test speed and temperature topping system.			X	
Test and calibrate backup overspeed monitor (OSM).[2]			X	
Verify calibration of temperature monitors.			X	
Check and calibrate all temperature and pressure gages/switches.			X	
Test and calibrate as necessary all safety, warning, and shutdown devices.			X	

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Table 1.6.1 Maintenance - Electrical and Control Systems, Contd

System/Description	D	M	S	A
Test package vibration monitor and calibrate transducers.				X
Change lithium battery in PLC, or controller.[2]				X

NOTES:

(1) Checks can only be performed with the unit shut down.

(2) See MAINTENANCE in Electrical Control System Chapter of this volume.

Table 1.6.2 Maintenance - Air Systems

System/Description	D	M	S	A
Periodic Checks				
Check air inlet system for obstructions and contamination.[1] Record differential pressure.[2]		X		
If air dryer installed, check its operation.[1]		X		
Inspect engine compressor variable guide vane mechanism for wear or corrosion. Check for bent lever arms, loose linkages or bushings, and seized guide vanes.[1, 3]		X		
Inspect intake and exhaust systems for damage, leaks, and debris.[1]			X	
Periodic Maintenance Tasks				
Check and calibrate IGV (Inlet Guide Vane) activation system.			X	
Apply corrosion inhibitor to variable guide vane system linkage.[1, 3]		X		
Inspect and replace air inlet filters as needed.[2]			X	
If self-cleaning air filter installed, check supply pressure, manually cycle through cleaning operation.		X		
Disassemble, clean, inspect, and reassemble bleed valve.				X

(1) Checks can only be performed with the unit shut down.

(2) Air inlet filters should be replaced per manufacturer's recommendation. As a guide, barrier filters require service if differential pressure reaches the alarm setpoint, normally 5 in. water (12.7 cm water). Prefilters require service if the differential pressure increases 1.0 to 1.5 in. water (2.5 to 3.8 cm water) above baseline.

(3) Refer to Service Bulletin 8.6/112.

Table 1.6.3 Maintenance - Lube Oil and Servo Oil Systems

System/Description	D	M	S	A
Periodic Checks				
Check oil tank level every 24 hours. Record oil consumption.	X			

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Table 1.6.3 Maintenance - Lube Oil and Servo Oil Systems, Contd

System/Description	D	M	S	A
Verify proper operation of oil makeup system, if installed.	X			
If applicable, check oil cooler belt tension.[1]			X	
Check oil cooler louver operation as applicable.		X		
If applicable, check lube oil tank vent fan and mist precipitator for proper operation.		X		
Check and record lube oil filter differential pressure. Change filters if differential pressure limit exceeded.		X		
Check servo oil filter "pop-up" indicator, if so equipped; change filter if popped.	X			
Check oil cooler core; clean as necessary.			X	
Periodic Maintenance Tasks				
Take lube oil sample for laboratory analysis. [2]		X		
Check lube oil system for leaks.		X		
Inspect and replace lube oil and servo oil filters as needed.[3]			X	
Lubricate oil cooler fan shaft bearings.			X	

(1) Checks can only be performed with the unit shut down.

(2) See Solar Engineering Specification 9-224 for oil replacement criteria.

(3) Lube oil and servo oil filter elements should be replaced when visible contamination is present, when differential pressure "pop-up" indicators are popped, or when differential pressure limits are exceeded. Filters should be replaced no less than annually.

Table 1.6.4 Maintenance - Seal Oil System (if applicable)

System/Description	D	M	S	A
Periodic Checks				
Check degassing tank oil level and temperature, as applicable.	X			
Check seal oil sight gages for proper flow direction of oil and gas.		X		
Check seal oil system for leaks.		X		
Check seal oil filter, record differential pressure. Change filter if differential pressure exceeds limits (or if "pop-up" indicator is popped, as applicable).		X		
Check buffer air and buffer gas filters; replace as necessary.		X		
Check overhead seal oil tank sight gage, if applicable.		X		
Check seal oil coalescer elements; replace if necessary.			X	
Periodic Maintenance Tasks				
Replace seal oil supply filters.				X
Inspect and clean seal oil trap inlet strainers.				X

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Table 1.6.4 Maintenance - Seal Oil System (if applicable), Contd

System/Description	D	M	S	A
Disassemble and rebuild seal oil traps.				X
Clean and inspect seal oil and buffer gas differential pressure regulating valves.				X

Table 1.6.5 Maintenance - Dry Gas Seal System (if applicable)

System/Description	D	M	S	A
Periodic Checks				
Check seal gas and buffer air pressure settings.	X			
Check and record dry gas seal leakage on each end of each compressor, as applicable.		X		
Check gas system for leaks.		X		
Check and record seal gas and buffer air coalescing filter differential pressure. Replace element if differential pressure exceeds 20 psi (138 kPa).			X	
Periodic Maintenance Tasks				
Drain buffer air coalescer (and seal gas coalescer, if applicable).		X		
Replace buffer air and seal gas coalescing filter elements.			X	
Clean and inspect dry gas seal system differential pressure regulating valves, as applicable.			X	

Table 1.6.6 Maintenance - Gas Fuel System (if applicable)

System/Description	D	M	S	A
Periodic Checks				
Inspect fuel control system for security and leaks, and visually inspect linkages and connections.[1]			X	
Check gas fuel system for leaks.		X		
Inspect fuel valve(s); clean as necessary.[1]				X
Periodic Maintenance Tasks				
Record fuel pressure, adjust at off-skid regulator if necessary.	X			
Disassemble, clean, and rebuild gas valves as applicable.			X	
Remove and inspect igniter torch housing for cracks, excessive erosion; inspect discharge tube for chafing wear.			X	
Rebuild or replace solenoid valves and regulators including those for air assist.				X

(1) Checks can only be performed with the unit shut down.

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Table 1.6.7 Maintenance - Liquid Fuel System (if applicable)

System/Description	D	M	S	A
Periodic Checks				
Check low-pressure fuel pump operation, if installed.		X		
Check high-pressure fuel pump for leaks and noise.		X		
Check liquid fuel system for leaks.		X		
Check high-pressure fuel filter. Clean or replace as necessary.[1]		X		
Observe fuel control performance (stability, start time, lightoff time during start).		X		
Check operation of fuel control valve. Verify T5 temperatures during start; compare with original data if available.			X	
Periodic Maintenance Tasks				
Inspect and replace filters as needed.[2]				X
Disassemble and lubricate fuel shutoff valves; reassemble with new O-rings.			X	
Inspect air purge manifolds for discoloration, cracks, and signs of overheating.			X	
Remove and inspect fuel injectors. Clean as needed.			X	
Rebuild or replace solenoid valves and regulators including those for air assist.				X

(1) Checks can only be performed with the unit shut down.

(2) Fuel filter elements should be replaced when visible contamination is present, when differential pressure "pop-up" indicators are popped, or when differential pressure limits are exceeded. Filters should be replaced no less than annually.

Table 1.6.8 Maintenance - Dual Fuel System (if applicable)

System/Description	D	M	S	A
Periodic Checks and Maintenance Tasks				
Conduct fuel transfer during operation. Observe speed, temperature, and load readings for stability.			X	
Check fuel system for leaks.		X		

Table 1.6.9 Maintenance - Water Injection System (if applicable)

System/Description	D	M	S	A
Periodic Checks				
Check water pump belts for proper tension.[1]			X	
Periodic Maintenance Tasks				

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Table 1.6.9 Maintenance - Water Injection System (if applicable), Contd

System/Description	D	M	S	A
Grease and tighten water pump seals.			X	
Change oil in water pump.			X	

(1) Checks can only be performed with the unit shut down.

Table 1.6.10 Maintenance - Start System and Auxiliary Motors

System/Description	D	M	S	A
Periodic Checks				
Inspect and test pre/post lube oil pump, seal oil pump, backup lube oil pump, and backup seal oil pump, as applicable.[1]			X	
Inspect starter clutch, if applicable, to ensure lock-up in one direction and free rotation in the other.[1]			X	
Visually inspect starter gas seals.[1]			X	
If electrohydraulic start system, check oil reservoir level.	X			
Periodic Maintenance Tasks				
For electrohydraulic start systems, obtain oil sample from starter system for laboratory analysis.[2]				X
For electrohydraulic start systems, change start system filters.				X
For pneumatic start systems, change lube oil.[3]				X

(1) Checks can only be performed with the unit shut down.

(2) See Solar Engineering Specification 9-347 for oil replacement criteria. Sample more frequently if greater than normal number of starts is performed.

(3) Lube oil should be replaced after each 500 starts.

Table 1.6.11 Maintenance - General

System/Description	D	M	S	A
Periodic Checks				
Be alert for any unusual operating condition (vibration, noise, etc.).	X			
Inspect all lines and hoses for leaks, wear, chafing; correct as necessary.	X			
Inspect all mechanical linkages for wear, looseness; correct as necessary.	X			
Visually inspect entire package for fuel, oil, and air leaks.	X			
Visually inspect integrity of fasteners, auxiliary motor couplings, bleed valve, and fuel control linkages.		X		
Check condition and operation of solenoids and shutoff valves.[1]			X	
Inspect package for unusual noise, discoloration, cracks, and chafing lines.		X		

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Table 1.6.11 Maintenance - General, Contd

System/Description	D	M	S	A
Visually inspect exhaust bellows for cracks or distortion.				X
Periodic Maintenance Tasks				
Record all panel readings, check that all oil-filled gages are filled.[2]		X		
Conduct engine performance analysis. Perform ingestive cleaning if necessary and at least semiannually.[2]		X		
Conduct borescope inspection of turbine.			X	
Lubricate all electric motors equipped with grease fittings.			X	
Check all safety relief valves as required by local regulations.			X	
Clean entire package.			X	
Remove seal oil pump from accessory drive (if installed). Inspect shaft splines for wear or evidence of seal leakage. Inspect accessory drive internally. Reinstall seal oil pump using new gasket.				X
If applicable, disassemble interconnect shafts and inspect splines for wear. Reassemble using new O-rings.				X
Check and adjust alignment of engine, gear unit, and compressor(s) as applicable.				X
Restart turbine and record acceleration time. Monitor control system for proper sequencing.			X	
Conduct vibration survey for trending.[2]			X	
Sample NOx water quality and record results.[3]	X			
Sample fuel(s) for specific gravity, lower heating value (LHV), dew point and composition, and record results.[3]				X
For marine applications, lubricate the gimbal bearings and the slider in the primary package support tie-downs with National Lubricating Grease Institute (NLGI) Grade 2, lithium-based grease with extreme pressure (EP) and molybdenum disulfide additives. Pump grease into the Zerk fittings until fresh grease is extruded from the bearing grooves. Wipe away excess surface grease.		X		

(1) Checks can only be performed with the unit shut down.

(2) Maintenance tasks, except for these, require machine shutdown.

(3) See Solar Engineering Specification 9-98 for NOx water quality and for fuel data.

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