Power Magic
400V C&I
Maintenance Manual

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No.	Unit	Maintenance interval	Task	Test instructions	Acceptance criterion	Notes
1	General	Daily	1. Access the PM's web interface and check for any alarms relating to the liquid cooling system, fire protection and the operational status of the PCS, including electrical parameters (voltage, current), insulation and operating conditions.	1. Access the PM's local web interface and check the 'Alarm/Fault Log' section to verify whether there are any alarms, warnings or faults.	1. No alarms, faults or anomaly reports on the PM's web interface.	
2	Liquid cooling circuit	Half-yearly	1. Check that all pipe connections (including valves, metal hoses and threaded, clamp and flanged fittings) are secure and intact.	1. Carry out a visual and manual inspection to check that there are no loose bolts or pipe fittings in the liquid cooling system. 2. If any are found to be loose, tighten them using suitable equipment (e.g. a torque wrench).	1. No loose connections. 2. Following tightening, the connections are correctly secured and free from faults.	
3	Liquid cooling circuit	Half-yearly	2. Check the operating pressure parameters (Outlet Water Pressure and Input Water Pressure) of the cooling system.	1. Check the current operating parameters on the PM web pages.	1. Operating parameters are within acceptable ranges. 2. If the pressures are out of range (i.e. low), top up the system.	**Acceptable ranges:** 1. Standby mode: Outlet Water Pressure (kPa) and Input Water Pressure (kPa) should be within the following ranges: A. 20–30 °C: 170–190 kPa; B. 10–20 °C: 150–170 kPa; 2. Self-circulating operation: A. 20–30 °C: Input Water Pressure: 150–180 kPa; Outlet Water Pressure: 230–270 kPa. B. 10–20 °C: Inlet water pressure: 120–150 kPa; Outlet water pressure: 200–220 kPa.

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4	Liquid cooling circuit	Half-yearly	3. Expansion tank.	Carry out a visual inspection of the expansion tank to check for any fluid leaks at the connection points.	No fluid leakage from the expansion tank.	
5	Liquid cooling circuit	Every six months	4. Water circulation pump.	1. Carry out a visual and auditory inspection of the circulation pump to detect any operational faults. 2. Check the operating parameters for the coolant's pressure and temperature, ensuring there are no abnormalities.	1. No abnormal noises or vibrations during operation. 2. No fluid leaks from the pump housing or fittings. 3. No signs of corrosion on the external surface.	1. Requires maintenance involving the shutdown of the system by qualified personnel. 2. Requires maintenance involving the shutdown of the system by qualified personnel. 3. Clean the areas affected by corrosion/rust.
6	Liquid cooling circuit	Half-yearly	5. Compressor.	1. Carry out a visual and auditory inspection of the compressor to detect any operational faults. 2. Check the operating parameters for pressure and temperature, ensuring there are no abnormalities.	1. No abnormal noises or vibrations during operation. 2. Operating parameters (pressure and temperature) within the nominal limits. 3. No signs of corrosion on the external surface.	1. Requires maintenance involving system shutdown by qualified personnel. 2. Requires maintenance involving system shutdown by qualified personnel. 3. Clean the areas affected by corrosion or rust.
7	Liquid cooling circuit	Half-yearly	6. Heat exchanger.	1. Carry out a visual inspection of the heat exchanger core to detect any anomalies or deterioration. 2. Carry out a visual inspection of the body and fittings to check for any faults or damage.	1. The foam filter (filter element) must be free from damage. 2. No fluid leaks from the housing or fittings.	1. Replace the sponge if it is damaged. 2. In the event of leaks from the housing, carry out maintenance whilst the system is shut down by qualified personnel; if no qualified personnel are available, retighten the fittings.
8	Liquid cooling circuit	Half-yearly	7. Electrical components.	1. Carry out a visual and manual inspection of cables and pipework to check for any damage or signs of ageing. 2. If any are loose, tighten the relevant cables and pipes correctly. 3. If any damage or deterioration is found, replace the components.	Cables and conduits are intact, with no damage or signs of ageing.	

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9	Liquid cooling circuit	Every six months	8. Check for any build-up of dust at the air inlets and outlets of the liquid cooling unit.	1. Carry out a visual inspection of the grilles and the air inlets and outlets of the liquid cooling unit, ensuring that there are no obstructions in any of the air intakes of the compartment or the unit. 2. If any obstructions are found, remove them and clean the affected surfaces.	No dust or foreign objects obstructing the air inlets and outlets.	If there are any obstructions or dust build-up, remove them and clean the area.
10	Liquid cooling circuit	Every six months	9. Check that there are no coolant leaks in the cooling system pipework.	1. Carry out a visual inspection of the liquid cooling unit and the radiator compartment to check for any leaks of red coolant. 2. If any leaks are found, check for loose connections, tighten the fittings and check whether the leak persists.	1. No coolant leaks from the cooling unit or the pipework.	
11	Liquid cooling circuit	Annual	1. Electrical components.	Carry out a visual and manual inspection of quick-connect or wired connections to check that they are not loose.	Power and communication connections are securely fastened with no looseness.	Tighten any loose connections.
12	Liquid cooling circuit	Annual	2. Check the pH value.	1. Draw a small amount of coolant from the manual bleed valve (approximately 15 ml). 2. Measure the pH value using a suitable measuring instrument. 3. If the pH value is not within the required range, replace the coolant.	The coolant must have a pH value of ≥ 7.4; if not, replace the coolant.	
13	Liquid cooling circuit	Annual	3. Carry out a test run of the liquid cooling system, checking for any abnormal noises, fault alarms or non-conformities.	Access the touchscreen panel and manually set the cooling and heating modes, running each for 10 minutes and recording the operating data.	No alarms or faults, and operating parameters within the nominal limits.	

14	Fire suppression system	Half-yearly	1. Smoke and temperature (fire) detectors.	Open the battery compartment door and carry out a visual inspection of the condition of the sensors.	The smoke and temperature detectors must be intact, free from mechanical damage, and the red indicator light must flash periodically when powered.	
15	Fire protection circuit	Every six months	2. Condition of the gas sensor.	1. Open the battery compartment door and carry out a visual inspection of the sensor. 2. Access the web page to check the concentration of combustible gases.	1. The gas sensor is intact and free from any disconnections or wiring faults. 2. The concentration of combustible gases detected by the monitoring system is within normal operating limits.	
16	Fire protection circuit	Half-yearly	3. Pressure of the fire-suppression system's cylinder assembly.	1. Open the door to the fire-fighting compartment of the storage cabinet and check the reading on the pressure gauge of the cylinder assembly. 2. Access the PM web page to check the cylinder pressure reading.	The pressure readings displayed on the pressure gauge in the fire suppression compartment and on the monitoring system must be consistent; the measured value must be between 1.8 MPa and 3.5 MPa.	
17	Fire-suppression circuit	Half-yearly	4. Inspection of the fire hydrant connection interface.	1. Open the fire hydrant compartment on the PM and carry out a visual inspection.	The hydrant connection must be correctly fitted and the protective cap must be in place.	
18	Fire-fighting circuit	Every six months	5. Check the condition of the non-return valves, pipe supports and pipes in the fire-fighting system.	1. Open the door to the fire protection compartment and the door to the storage cabinet, and carry out a visual inspection of the components.	1. The non-return valve must be intact and free from corrosion. 2. The pipe supports must be securely fastened and free from any looseness or detachment. 3. The pipework must be correctly secured and free from any looseness.	
19	Fire-fighting circuit	Half-yearly	6. Check the condition of the heat-sensitive element of the fire sprinklers.	Open the door of the storage cabinet and carry out a visual inspection of the heat-sensitive element of the sprinklers.	The heat-sensitive element of the sprinkler must be intact and free from damage.	

20	Fire protection circuit	Every six months	7. Check that the extinguishing agent cylinder is free from corrosion and deformation and that the relevant labels are intact.	Open the door to the fire suppression compartment and carry out a visual inspection of the extinguishing agent cylinder.	The extinguishing agent cylinder must be free from corrosion or external deformation, and the relevant labels must be intact and legible.	
21	Fire suppression system	Every six months	8. Check that the cylinder bracket is securely fastened.	Open the fire suppression compartment door and manually check the stability of the cylinder bracket by pulling gently on it.	The cylinder bracket must be correctly secured and free from any looseness.	
22	Fire-suppression system	Every six months	9. Check that the pipe caps and the nuts on the pipes connecting to the Pack are tight.	Open the battery compartment door, turn the pipe end cap anti-clockwise by hand and check the pipe connecting to the Pack.	The cap, when pulled slightly, must be correctly secured and must not come loose.	
23	Fire suppression system	Half-yearly	10. Fire suppression control unit.	Open the door of the auxiliary power supply panel and carry out a visual inspection of the fire control unit.	The fire control unit must be intact, with no obvious mechanical damage or deformation.	
24	Fire-suppression circuit	Annual	1. Functional test simulating gas discharge (Note: before the test, remove the solenoid valve coil from the cylinder assembly).	The test can be carried out using the product's dedicated equipment or a compatible nitrogen cylinder assembly available on site to simulate the gas discharge. Connection procedure: disconnect the high-pressure hose from the existing extinguishing agent cylinder assembly and connect the external device to the same hose, leaving the other pipe connections unchanged; the external gas source must be connected to a pressure gauge for pressure monitoring.	Pipe integrity: tested at 0.25 MPa for 3 minutes with no leaks. The pipes must not exhibit any vibration or damage, the plug must not come loose and the threaded fittings must remain tight.	Optional, depending on customer requirements and local standards and regulations.
25	PCS	Annual	1. Check the external appearance of the PCS for any damage or deformation.	1. Carry out a visual inspection of the product's exterior.	1. The PCS shows no signs of damage or deformation.	

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26	PCS	Annual	2. Check that the temperature of the terminals and surfaces is within acceptable limits and that there are no unusual odours.	1. Use a thermal imaging camera to measure the temperature of the PCS terminals and surfaces. 2. Check for any unusual odours (smell of burning). 3. In the event of any anomalies, shut down the PM and proceed to identify the problem and resolve it appropriately.	1. The temperature should not exceed the ambient temperature of +25℃. 2. No unusual odours.	
27	PCS	Annual	3. Check for any unusual noises whilst the product is in operation.	1. Listen to the product whilst it is operating to detect any unusual noises. 2. If any unusual noises are heard, locate the source of the noise, checking in particular for any foreign objects stuck in the PCS's external fan.	No unusual noises during operation.	
28	PCS	Annual	4. Check that air is circulating correctly in and out of the unit whilst it is in operation.	1. Check that air is circulating correctly in and out whilst the product is in operation, visually ensuring there are no obstructions in the grilles and ventilation ducts of the ESS's PCS compartment. 2. Switch off and secure the PM, then remove the fans to check their condition and that of the heat sink, in order to remove any impurities present. 3. If any foreign objects or dust build-up causing obstructions are found, remove and clean them.	No obstructions caused by foreign objects; air intake and outlet grilles and openings are clean and unobstructed.	
29	PCS	Annual	5. Check that the ambient temperature and humidity around the product comply with the requirements.	Measure the ambient temperature near the PCS.	The ambient temperature must be below 60°C.	

30	PCS	Annual	6. Check for any build-up of dust in the grilles and ventilation openings of the product.	1. Carry out a visual inspection of the grilles and ventilation ducts, including the air intake of the ESS PCS compartment, the internal air intake of the PCS compartment and the air outlet of the ESS PCS compartment, to check for obstructions and dust build-up. 2. If any foreign objects or dust build-up causing blockages are found, remove them and clean the area.	No foreign objects or dust build-up; grilles and ventilation openings clean and unobstructed.	
31	PCS	Annual	7. Check the integrity of the cable sheathing. Whilst the product is in operation, measure the temperature of the cable terminals using a thermal imaging camera and check that the connections are correctly tightened, ensuring there is no looseness.	1. Carry out a visual inspection of the cable insulation to check that it is undamaged. 2. Use the thermal imaging camera to measure the temperature of the cable terminals.	1. Cables must be intact, with no damage to the insulation. 2. Terminal temperature not exceeding ambient temperature +25 °C.	
32	PCS	Annual	8. Check that the warning labels and product identification plates are intact and legible.	1. Carry out a visual inspection of the identification plates and labels to check that they are present, legible and securely attached. 2. If any labels are illegible, damaged or deteriorated, replace them.	Labels and plates present, correctly secured and legible, with no detachment or damage.	
33	Cabinet	Half-yearly	1. Check that the door seals are intact.	1. Visually and/or manually inspect the door seals for damage or signs of ageing. 2. If damaged or worn, arrange for them to be replaced.	1. The seals fit snugly against the cabinet and show no signs of damage. 2. Carry out a water spray test to check for any leaks and apply sealant if necessary.	

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34	Cabinet	Half-yearly	2. Check the cabinet casing for damage, peeling paint, oxidation, etc.	1. Carry out a visual inspection of the PM's casing to verify its integrity and ensure there is no damage (peeling paint, signs of oxidation/corrosion, etc.). 2. If any damage is found, assess its extent and determine the appropriate corrective actions to restore the cabinet to good condition.	The cabinet appears to be intact and undamaged	
35	Cabinet	Annual	1. Check that the locks and hinges on the PM doors are working correctly.	1. Visual inspection and functional test by opening and closing the doors. 2. If they are not operating correctly, lubricate the locks (keyholes and mechanisms) and hinges with a suitable product.	The locks and hinges are working correctly, ensuring the doors open and close smoothly without jamming.	
36	Cabinet	Annual	2. Check that there are no flammable materials on top of or in the immediate vicinity of the cabinet.	1. Carry out a visual inspection of the top of and the area surrounding the cabinet to check for any flammable materials or objects. 2. Remove any non-compliant objects or materials immediately.	No flammable objects on top of or in the immediate vicinity of the PM	
37	Cabinet	Annual	3. Check the integrity of the welds between the cabinet and the base plate and check for any signs of corrosion.	1. Carry out a visual inspection of the welds between the PM and the base to check that they are sound and free from corrosion or rust.	The welds are intact and securely attached to the base, with no corrosion.	

38	Cabinet	Annual	4. Check that the identification plates and warning labels are legible and intact.	1. Carry out a visual inspection to check that identification plates and safety labels are present, legible and correctly secured. 2. If any labels are damaged, replace them.	Plates and labels present, securely fixed and clearly legible, with no detachment or deterioration.	
39	Annual	Annual	5. Check that there are no foreign objects, dust, dirt or condensation inside the ESS.	1. Carry out a visual inspection of the inside of the cabinet to check for any foreign objects, dust, dirt or condensation. 2. Remove any foreign objects and impurities found. 3. If condensation is present, dry the affected surfaces. 4. If dust or dirt is present, remove it (e.g. using forced air).	No foreign objects or condensed water	
40	Cabinet	Annual	6. Check the intake and exhaust vent temperatures and dust	1. Visually inspect the intake and exhaust vents for dust 2. If any is found, clean them using a vacuum cleaner	No foreign objects, dust or condensation inside the ESS.	
41	Cabinet	Annual	7. Check for any water ingress inside the cabinet.	1. Carry out a visual inspection of the interior of the PM to detect any signs of water ingress. 2. If water ingress is found, identify the cause of the leak and take action by sealing the affected areas or carrying out the necessary repairs.	No water ingress inside the PM.	

42	Cabinet	Annual	8. Check that all cable entry and exit points from the PM are properly sealed.	1. Carry out a visual inspection of the cable glands and cable entry/exit points to check that they are properly sealed. 2. In the event of inadequate sealing, ensure that all open cable entry/exit points are sealed.	Cable entry points must be fully sealed, with no openings or points through which animals or foreign objects could enter.	
43	Annual	Annual	9. Check for any signs of oxidation or corrosion inside the PM.	1. Carry out a visual inspection of the interior of the cabinet, including battery racks and conductive components, to detect any signs of oxidation or corrosion. 2. If oxidation or rust is present, take the appropriate corrective action using suitable tools and products.	Internal surfaces free from oxidation and corrosion.	
44	Electrical components	Half-yearly	1. Check that the emergency stop button is working correctly.	1. Press and then release the ESS emergency stop button, checking the status of the indicator light on the door panel and ensuring that the alarm is correctly displayed on the PM's web interface. 2. Check that, when the button is released, the system automatically returns to normal operating conditions and that the alarm is cleared. 3. If the emergency stop button is not functioning correctly and the integrity of the electrical connections has been verified, replace it and carry out the functional test again.	1. When the emergency stop button is pressed, the indicator light should turn red (alarm) and the web page should display the emergency alarm. 2. When the button is released, the indicator light returns to its normal state and the alarm message on the PM web page is cleared.	

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45	Electrical components	Half-yearly	2. Check the condition of the circuit boards and electrical components.	1. Carry out a visual inspection of the circuit boards and electrical components to check for any damage or dust build-up. 2. In the event of any faults, clean the surfaces and, if necessary, replace any damaged components.	1. The circuit boards and electrical components must be free from dust and any obvious damage.	
46	Electrical parts	Half-yearly	3. Check for any signs of corrosion on metal components.	1. Carry out a visual inspection of all metal components to detect any signs of corrosion or oxidation. 2. If any faults are found, carry out the appropriate corrective measures or replace the components.	Metal components free from corrosion or oxidation.	
47	Electrical parts	Annual	4. Check that the contactors are operating correctly.	1. Activate and deactivate the contactor via the PM's web interface and check that it switches (audible feedback). 2. If any faults are detected during switching, check for any mechanical jamming. 3. If a malfunction or jam is detected, replace the affected contactor.	The contactors perform opening and closing operations correctly, without jamming or operational faults.	
48	Electrical components	Annual	1. Check that the cables are correctly routed and that the insulation is intact.	1. Carry out a visual inspection of the power cable routing and the integrity of the insulation. 2. If any faults are found, ensure the cables are correctly laid and replace them if damaged. 2. Correct and rectify any faults immediately.	Cables must be correctly routed and in good order; cable sheaths and insulation must be free from damage.	

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49	Electrical components	Annual	2. Check the tightness and condition of the power and communication cable connections.	1. Carry out a visual inspection of the power and communication cables to check that there are no loose connections, damage or faults. 2. Whilst the system is in operation, carry out a thermographic inspection of the connection points, quick-connectors and cables to identify any abnormal overheating. 3. In the event of loose connections or abnormal temperatures, switch off the system completely and ensure the connections are correctly tightened to the specified torques. For plug-in connections, check that the connectors are correctly mated, using the appropriate personal protective equipment.	Power and communication cables correctly connected and secured; temperatures of connections and cables within normal operating limits.	
50	Electrical parts	Annual	3. Check the condition of the power and communication cables, paying particular attention to the points where they come into contact with metal surfaces.	1. Carry out a visual inspection of the power and communication cables to check for any damage to the outer sheaths, abrasions, cuts or signs of wear, particularly at points of contact with metal parts. 2. If any damage is found, replace the affected cables.	Cables must be intact and free from damage to the sheaths or insulation.	
51	Electrical components	Annual	4. Check the integrity and correct positioning of the heat-shrink insulating sleeves on the cable terminals.	1. Carry out a visual inspection of the heat-shrink insulating sleeves fitted to the cable terminals, checking that they are intact and properly adhered. 2. If any detachment, loosening or deterioration is found, restore the insulation by applying a new, suitable heat-shrinkable insulating sleeve.	The heat-shrink insulating sleeves on the cable terminals are intact, correctly positioned and free from detachment or deterioration.	

52	Electrical components	Annual	5. Check that the earthing system is correctly connected and verify the earth resistance value.	1. Measure the earth resistance of the equipment using a suitable earth resistance meter. 2. Check the continuity and correct connection of the earth conductors.	The earth connections are correctly installed and the earth resistance is less than 4 Ω.	
53	Electrical components	Annual	6. Check that the equipotential bonding connections inside the ESS are correctly installed and that there are no loose connections or signs of corrosion at the relevant connection points.	1. Visually check that the equipotential conductors are correctly connected and that there is no corrosion at the connection points. 2. Check that the equipotential connections are correctly tightened and that there is no loosening. 3. Retighten any loose connections and replace any corroded components, if present.	Equipotential conductors correctly connected and secured; no loosening or signs of corrosion at the connection points.	
54	Electrical components	Annual	7. Check the condition and correct operation of the extraction fans.	1. Manually start the fans via the PM web pages and check that they are operating correctly. 2. Check that there are no obstructions, vibrations or abnormal noises during operation. 3. In the event of a fault, check the electrical connections and replace the fans if necessary; then carry out a further functional test.	The fans are operating correctly, with no blockages or abnormal noises.	
55	Electrical components	Annual	8. Check the integrity and correct condition of the surge protection devices (SPDs) and fuses.	1. Visually check that the SPD status indicator is in the normal position (green). 2. Visually check that the surge arrester protection switch is in the normal operating position (closed). 3. Check that the SPD modules are correctly secured and free from any looseness. 4. Check that the fuse is correctly secured and that there is no looseness.	The surge protection devices (SPDs) are in normal operating condition; the isolating switch is in the operating position (closed); the SPD modules are correctly secured and free from looseness; the fuses are correctly installed and securely fastened.	

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56	Cabinet	Half-yearly	10. Switches	1. Visually and manually check the condition and operation of the door switches (cabinet/compartment doors), ensuring that they engage and disengage correctly in response to the door being opened and closed.	The door switches are correctly installed and operational, with consistent indication of the open/closed door status and no faults detected.	
57	Electrical components	Annual	9. Check PM firmware update	1. Access the PM's web page and check the installed firmware version, checking for any available updates. 2. If available, carry out the firmware update.	Firmware updated to the latest available version.	
58	Fire protection circuit	Annual	11. Check that the fire protection control unit firmware is up to date.	1. Connect to the fire control panel via an RS485 converter and the relevant software, checking for any available updates. 2. If available, carry out the firmware update.	Firmware updated to the latest available version.	

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