WHITEPAPER · OCCUPATIONAL & ENVIRONMENTAL HEALTH

Data Centres and Human Health: The Invisible Workforce Behind the Digital World

A comprehensive framework for occupational and environmental health governance in data centre operations — from arc flash hazards to IARC-classified carcinogens, safety-critical medical standards, and the emerging challenges of AI-era infrastructure.

Occupational Medicine | Environmental Health | DC Operations | EHS Governance | Regulatory Compliance | ESG & Sustainability | Safety-Critical Standards | Hyperscale Infrastructure

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The Most Under-Governed Workforce in the Digital Economy

Data centres are the central nervous system of artificial intelligence, cloud computing, and global digital infrastructure. They consume more electricity than many countries, house thousands of workers in complex industrial environments, and operate continuously — 24 hours a day, 365 days a year — under conditions that generate a unique and largely unaddressed occupational health burden.

This whitepaper presents the first comprehensive synthesis of occupational and environmental health risk in the data centre sector. It draws on published medical literature, IARC carcinogen classifications, international regulatory standards, and eight years of direct clinical experience in DC occupational health governance across hyperscale, enterprise, and colocation environments on three continents.

The core finding is this: the DC workforce is simultaneously exposed to multiple IARC-classified carcinogens, a biological hazard with a case fatality rate of up to 25%, safety-critical electrical conditions that can release energy equivalent to several kilograms of TNT — inside a building that may sit adjacent to schools, homes, and hospitals — and a thermal environment with no comparable precedent in published occupational health literature. Yet most facilities operate without a structured medical surveillance programme, a defined safety-critical role framework, or a coherent environmental health strategy.

For DC operators and hyperscalers, this represents three categories of risk: regulatory liability (occupational health legislation in the EU, UK, and US imposes mandatory surveillance obligations that most facilities are not meeting); ESG and investor risk (workforce health and environmental impact are increasingly material to institutional investment and sustainability reporting — a facility without documented occupational health governance cannot demonstrate adequate social responsibility under CSRD ESRS S1); and operational resilience risk (the most dangerous health consequences in the DC environment — arc flash, refrigerant asphyxiation, heat stroke, Legionnaires' disease — directly threaten facility availability and business continuity).

Prime OH Intl. has developed a complete DC Occupational Health Framework — the first of its kind globally — encompassing a 360° risk management roadmap, a medical surveillance programme, a safety-critical role classification system, and a cross-reference tool mapping all 204 DC roles against 19 health surveillance categories. This whitepaper summarises that framework and makes the case for its universal adoption.

THE ESG ACCOUNTABILITY STATEMENT

The Social (S) in ESG is measured by how an organisation manages the health and safety of the people who build and operate its infrastructure. Under CSRD ESRS S1, disclosure of systematic workforce health governance is a mandatory reporting obligation for large undertakings from 2025. A facility without a documented occupational health framework cannot demonstrate adequate social responsibility to investors, lenders, or institutional clients. This is not a compliance question — it is a board accountability question.

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415 TWh
Global DC electricity consumption, 2024 — more than France

2
IARC Group 1 definite carcinogens present in standard DC environment

25%
Case fatality rate for Legionnaires' disease in immunocompromised DC workers

86%
Of data processing workers report musculoskeletal pain — Woods, Occup. Med., 2005

0
Published prospective cohort studies specifically tracking DC worker health outcomes

204
DC roles mapped to 19 OH risk exposure categories in the Prime OH Intl. framework

SECTION 01

The Data Centre as an Occupational Health Environment

> Data centres are routinely described in terms of their uptime, their power usage effectiveness, and their network connectivity. They are rarely described in terms of what they are to the people who work inside them: complex, multi-hazard industrial environments with no close analogue in any existing occupational health framework.

Walk through a modern hyperscale data centre and you encounter, within a few hundred metres, conditions that would be immediately recognisable to an occupational health professional working in heavy industry, chemical manufacturing, building services engineering, logistics, and psychiatric nursing — all simultaneously. Server halls with noise levels of 92–96 dB(A) that would mandate audiometric surveillance in any comparable industrial setting. Hot aisles at 40–45°C adjacent to cold aisles at 10–15°C, creating a thermal cycling environment with no precedent in published occupational health literature. High-voltage switchgear with available fault currents capable of releasing energy equivalent to several kilograms of TNT as a pressure wave, superheated plasma, and optical radiation burst — inside a building that may sit adjacent to schools, homes, and hospitals. Cooling towers perpetually at the optimal temperature for *Legionella pneumophila* proliferation. Generator rooms where diesel exhaust — definitively classified by IARC as a Group 1 human carcinogen — is an unavoidable product of weekly mandatory testing. And a Network Operations Centre populated by people working 12-hour night shifts, alone, under artificial light, monitoring critical infrastructure that serves millions of people, with the constant awareness that a missed alert could trigger a cascading failure.

What makes the DC environment distinctive is not the severity of any single hazard — comparable or worse hazards exist in many industries — but the simultaneous co-location of so many distinct risk categories within a single facility, and the near-total absence of a structured occupational health governance response. The majority of data centres globally operate without a documented medical surveillance programme, without a defined safety-critical role framework, and without a clinical understanding of how their specific combination of hazards interacts to produce health outcomes that cannot be predicted from any single-hazard study.

The Workforce Behind the Infrastructure

The direct DC workforce is estimated at approximately one million people globally in 2026 — a figure that has grown at double-digit annual rates for the past decade and is accelerating with the AI-driven expansion of hyperscale capacity. This workforce is not homogeneous. The Prime OH Intl. DC Job Roles Directory identifies 204 distinct role types across 18 functional areas, spanning NOC analysts and data centre technicians at the operational core, through electrical and HVAC engineers in the critical infrastructure, to logistics operatives, security personnel, and executive leadership. Each role group carries a distinct hazard exposure profile, a distinct surveillance requirement, and — for several groups — a distinct safety-critical medical standard that has no equivalent in any existing industry-specific OH guidance.

THE BUSINESS CASE — THREE DIMENSIONS OF RISK

Regulatory liability: EU, UK, and US occupational health legislation imposes specific mandatory surveillance obligations — audiometry where daily noise exposure exceeds 85 dB(A); spirometry for chemical hazard exposures; Legionella Water Safety Plans; EMF risk assessments under EU Directive 2013/35/EU. Most DC facilities are not meeting these obligations in full.

ESG and investor risk: The Social dimension of ESG — specifically workforce health, safety culture, and environmental health impact — is an increasingly material factor in institutional investment, insurance pricing, and M&A due diligence. A facility without documented OH governance cannot demonstrate adequate social responsibility.

Operational resilience: The most dangerous health consequences in the DC environment — arc flash, refrigerant asphyxiation, heat stroke, Legionnaires' disease — are also direct threats to facility availability. A Legionella outbreak triggers mandatory cooling tower shutdown. A heat stroke incident in a server hall may require emergency evacuation. These are not abstract health concerns; they are facility continuity risks.

SECTION 02

Electrical Scale, Power Density, and Environmental Impact

> To understand the occupational health risk of the data centre, you must first understand its scale. And the scale is extraordinary.

Global data centre electricity consumption reached 415 terawatt-hours in 2024 — equivalent to the entire annual power consumption of France, and representing approximately 1.5% of all electricity generated on Earth. The International Energy Agency projects this will reach 945 TWh by 2030, equivalent to Japan's total current electricity consumption. In the United States alone, data centres will consume more electricity by the end of this decade than all energy-intensive manufacturing industries combined: aluminium, steel, cement, and chemicals. The driver is artificial intelligence. AI-optimised server racks draw 40–80 kW per rack — compared to 5–10 kW for a conventional rack — and the IEA projects that AI-focused servers will account for nearly half of net growth in global DC electricity consumption between 2024 and 2030.

415 TWh GLOBAL DC ELECTRICITY CONSUMPTION, 2024 IEA, Energy and AI, 2025	**945 TWh** PROJECTED BY 2030 — EQUIVALENT TO JAPAN TODAY IEA, 2025	**100 MW+** SINGLE-SITE POWER DEMAND — LARGEST HYPERSCALE CAMPUSES Industry data, 2025	**300,000** GALLONS OF WATER CONSUMED PER DAY — AVERAGE DC Lawrence Berkeley NL, 2024

Arc Flash: The Hazard That Can Reach Beyond the Fence

A single large hyperscale data centre draws between 20 and 100 megawatts of power continuously. Power arrives at the site at high voltage — typically 33 kV, 66 kV, or 132 kV — through dedicated substations. It is then transformed down through multiple stages: medium-voltage switchgear (11 kV or 6.6 kV), UPS systems, automatic transfer switches, and rack-level power distribution units. At every transformation stage, the available fault current — the energy that could be released in an uncontrolled electrical event — is enormous.

An arc flash is not an electrical fault. It is a plasma explosion. When an electrical arc forms — triggered by a dropped tool, a maintenance error, insulation degradation, or equipment failure

— it releases energy at approximately 20,000°C, four times the surface temperature of the sun. The associated pressure wave can exceed 150 dB. At incident energy levels of 40+ cal/cm² — readily achievable in medium-voltage data centre switchgear — no commercially available personal protective equipment provides reliable protection. The only engineering control is exclusion.

COMMUNITY RISK — BEYOND THE SITE BOUNDARY

A major arc flash event at a 132 kV incoming substation — of the kind feeding a 100 MW data centre — does not respect the site boundary. Blast overpressure can shatter windows and collapse lightweight structures within dozens of metres. If the arc propagates to the main transformer, the resulting oil fire — fed by thousands of litres of dielectric oil — is not controllable by standard suppression. Toxic combustion products disperse downwind. Grid operators may be required to manage the sudden loss of hundreds of megawatts of load in real time. Planning authorities in most jurisdictions currently impose no mandatory consequence assessment for these scenarios. This is a regulatory gap of the highest significance.

Environmental Footprint: Carbon, Water, and Land

The environmental health impact of data centres operates across three dimensions, all of which affect the communities in which they operate. Carbon: data centres and data transmission networks combined account for roughly 200 million tonnes of CO_2 annually — more than the entire emissions of Argentina. AI systems alone may generate between 32.6 and 79.7 million tonnes of CO_2 in 2025 (de Vries-Gao, *Patterns*, 2025). Water: the average DC consumes 300,000 gallons of water per day; the global water footprint of AI systems could reach 764.6 billion litres in 2025 — comparable to global annual bottled water consumption (VU Amsterdam, 2025). Of China's computing capacity, 72% sits in severe water-scarce regions. Land and community: DC clusters in Northern Virginia, Dublin, Frankfurt, and Singapore have measurably constrained local grid capacity, increased residential electricity pricing, and in some cases restricted grid connection for new housing and commercial development.

These environmental dimensions are directly relevant to occupational health. Workers in DC-adjacent communities — including families of DC employees — are exposed to diesel exhaust from generator testing, Legionella drift from cooling towers, noise from plant equipment, and electromagnetic fields from HV grid connections. The occupational health professional's duty of care does not end at the site perimeter.

SECTION 03

Occupational Disease: What the Evidence Base Tells Us

> No large-scale prospective cohort study of DC workers exists. But the literature on the specific hazard exposures present in DC environments — drawn from comparable industrial populations — is substantial, clinically actionable, and largely ignored by the sector.

The absence of a DC-specific epidemiological cohort is not a justification for inaction. Every hazard present in the data centre environment has been studied in comparable populations. The evidence is sufficient to define surveillance requirements, clinical action thresholds, and fitness-for-work standards with confidence. What follows is a summary by organ system.

Cancer Risks

Night shift work is classified by IARC as a Group 2A probable carcinogen — on the basis of sufficient experimental evidence and strong mechanistic data showing that circadian disruption impairs DNA repair mechanisms, suppresses melatonin-mediated immune surveillance, and deregulates cell cycle clock genes. The epidemiological evidence supports an association with breast cancer (RR approximately 1.1–1.6 for long-duration shift workers), prostate cancer, and colorectal cancer. Every NOC operator, shift engineer, and overnight security officer in a 24/7 DC facility is exposed to this classified carcinogen. An estimated one in five workers globally is currently exposed to this risk — yet it is not addressed in any existing DC safety management standard.

Diesel engine exhaust was reclassified by IARC in 2012 to Group 1 — a definite human carcinogen, causing lung cancer with sufficient evidence from human epidemiological studies. Vermeulen et al. (2014) estimated 17 excess lung cancer deaths per 10,000 workers at 1 $\mu g/m^3$ elemental carbon lifetime exposure — a level achievable during routine 30-minute generator load tests in enclosed plant rooms. Bladder cancer association is also classified at Group 1 level (limited evidence). Every DC with a diesel generator — which is to say, every Tier III and Tier IV facility globally — has this IARC Group 1 carcinogen in its operational footprint.

UV radiation (IARC Group 1) is an under-recognised hazard for roof-level maintenance staff — those performing weekly cooling tower checks, AHU inspections, and exhaust stack monitoring. Standard DC PPE is not designed for UV protection. No sun protection programme is documented in any DC occupational health framework in the existing literature.

IARC-CLASSIFIED EXPOSURES PRESENT IN STANDARD DC OPERATIONS

Exposure	IARC Classification	DC Source	Primary Exposed Groups	Cancer / Health Association
Diesel engine exhaust	Group 1	Generator testing; loading bay	Electrical engineers; logistics	Lung cancer (sufficient); bladder cancer (limited)
UV radiation (UVA/UVB)	Group 1	Roof maintenance, cooling towers, AHU	HVAC; mechanical	SCC; BCC; melanoma
PM2.5 (outdoor air pollution)	Group 1	AHU intake (wildfire smoke; traffic pollution)	All groups via ventilation	Lung cancer; COPD
Night shift work	Group 2A	NOC; 24/7 shift operations; security	NOC operators; shift engineers; security	Breast; prostate; colorectal cancer; metabolic syndrome
ELF magnetic fields	Group 2B	HV switchgear; UPS; busbars; transformers	Electrical engineers; HVAC	Childhood leukaemia (residential); adult brain tumour (inconsistent)
Radiofrequency EMF	Group 2B	Wi-Fi; server RF interfaces; roof base stations	All groups (background)	Glioma (limited evidence)

Hearing Loss, Musculoskeletal Disease, and Thermal Injury

Noise-induced hearing loss is the most robustly documented occupational health outcome in the DC environment. Direct measurements by Alnuaimy and Shushura (2022) recorded average sound levels of 92 dB(A) in server areas, with peaks within rack enclosures reaching 96 dB(A). Both the NIOSH REL (85 dB(A)) and the OSHA PEL (90 dB(A)) are regularly exceeded during routine maintenance work. NIHL is irreversible — there is no treatment that restores cochlear hair cells once damaged. The characteristic 4 kHz audiometric notch allows early detection if annual audiometry is performed.

Musculoskeletal disorders carry perhaps the most striking statistic in the DC health literature: Woods (2005), in a landmark study of data processing workers, found that 86% reported musculoskeletal pain or discomfort in the previous year, with 58% affected at the neck, and visual strain reported by 47% of participants. This prevalence was independently associated with psychosocial factors — low task control, job dissatisfaction — as well as physical ergonomic demands.

The thermal paradox is unique to the DC environment and has no comparable precedent in published occupational health literature. A server hall technician may transit from a coldaisle temperature of 10–15°C to a hot-aisle temperature of 40–45°C within a lateral distance of less than two metres, and may repeat this transit dozens of times in a single shift. The physiological demands of repeated rapid thermal cycling — cardiovascular reversal between vasoconstriction and vasodilation, thermoregulatory fatigue, blunted thirst sensation in cold aisles creating underestimated dehydration risk — have not been systematically studied. The renal consequences of hot-aisle heat stress are well characterised: a systematic review in *Frontiers in Public Health* (2023) confirmed consistent evidence linking high industrial temperatures with acute kidney injury, renal calculi, and progression to CKD.

Legionella represents the most acute fatality risk in the DC environment from a single biological exposure event. *Legionella pneumophila* thrives at 25–45°C — precisely the temperature maintained in DC cooling tower water circuits. The case fatality rate is 5–15% in otherwise healthy individuals and up to 25% in immunocompromised persons. For DC workers with shift work-impaired immune function, this elevated risk at the individual level is clinically significant. OSHA estimates 8,000–18,000 US hospitalisations annually from Legionnaires' disease, the majority misclassified as community-acquired pneumonia.

> ***"The DC workforce is simultaneously exposed to multiple IARC-classified carcinogens, a biological hazard with a case fatality rate of up to 25%, and a thermal environment with no precedent in occupational health literature — yet most facilities operate without a structured surveillance programme."***
>
> PRIME OH INTERNATIONAL — DC OCCUPATIONAL HEALTH RISK MANAGEMENT ROADMAP, 2026

SECTION 04

Medical Surveillance: What Good Looks Like

> A medical surveillance programme is not a box-ticking compliance exercise. It is a clinical system for detecting work-related health effects at the earliest reversible stage — while there is still time to intervene.

The Prime OH Intl. DC Medical Surveillance Programme (DC-OH-MSP-001) defines role-specific surveillance protocols for all 204 DC roles, grouped into eight occupational health risk groups (A–H) based on shared hazard exposure profiles. Each group has defined pre-employment baseline requirements, periodic surveillance tests and frequencies, action thresholds, and referral pathways. The programme distinguishes explicitly between legally mandatory assessments and best-practice gold-standard recommendations — a distinction that is essential for EHS budget prioritisation.

The Eight Role Groups and Their Primary Hazard Drivers

A

Office / Admin / Executive

DSE; psychosocial; sedentary work. Standard surveillance: pre-employment baseline + DSE assessment.

B

NOC / 24-7 Shift Operations

IARC 2A (night shift); cardiovascular / metabolic disease; depression; OSA; isolation. Highest surveillance intensity of all groups.

C

DC Operations — Server Halls

Noise 92–96 dB(A); thermal paradox; manual handling; confined space. Annual audiometry mandatory.

D

Electrical Engineering

Arc flash; diesel exhaust (IARC Group 1); EMF / cardiac implant risk; battery hazards; height; noise. Group 2 Modified medical standard.

E

Mechanical / HVAC / Refrigeration

F

Logistics / Loading / Forklift

L egionella (fatal); refrigerant O_2 displacement; biocide sensitisers; SCBA demands; height. Co-equal highest surveillance intensity.

G roup 2 medical (vehicle operation); diesel exhaust (IARC Group 1); WBV; HAV; manual handling.

G

Physical Security

S hift work; violence / aggression (PTSD risk); physical fitness demands; DSE (CCTV); lone working.

H

Long-term Contractors

A ssign to A–G based on work type. DC-specific orientation health requirements apply regardless.

Key Surveillance Components and Mandatory vs Best Practice

The following assessments are legally mandatory in most EU, UK, and US jurisdictions for the relevant role groups. Non-compliance constitutes a regulatory breach:

Assessment	Mandatory Trigger	Frequency	Applicable Groups
Audiometry (pure tone air conduction)	LEP,d >85 dB — Noise at Work Regs / OSHA 29 CFR 1910.95	Annual	C, D, E, F (and G where exposed)
Spirometry (FEV_1, FVC, FEV_1/FVC)	Chemical / respiratory hazard exposure — COSHH Regs 2002	Annual (Group E); 2-yearly (C, D)	C, D, E
Legionella Water Safety Plan + monitoring	Any evaporative cooling system — L8/HSG274 ACOP	Microbiological monitoring per WSP; serology 2-yearly	E (water treatment)
DSE assessment + eye test	Regular screen use — EU DSE Dir. 90/270/EEC; DSE Regs 1992	Pre-employment + every 2 years	A, B, G
EMF risk assessment + cardiac implant screen	Occupational EMF exposure — EU Dir. 2013/35/EU	Pre-employment + on implant receipt	D, E
Forklift Group 2 medical	Vehicle operation — DVLA / OSHA equivalent	3-yearly (<45 yrs); annual (45+)	F
SCBA annual fitness certificate	Respiratory protective equipment use — COSHH / OSHA 134	Annual — no exceptions	E; D (where SCBA-authorised)
Blood lead (VRLA battery maintenance)	Lead exposure >0.05 mg/m³ — Control of Lead Regs 1998	Baseline + 3-monthly if elevated	D

In addition to mandatory assessments, the Prime OH Intl. framework defines a comprehensive best-practice surveillance layer for the highest-risk groups — most critically, the annual metabolic and psychological panel for Group B (NOC / shift workers), encompassing PSQI, Epworth Sleepiness Scale, PHQ-9, GAD-7, blood pressure, fasting lipids, HbA1c, BMI, and cancer screening signposting. This panel addresses the IARC 2A carcinogen exposure, the cardiovascular and metabolic consequences of circadian disruption, and the documented mental health burden of the DC NOC environment — none of which are currently captured in any standard workplace health programme.

SECTION 05

Safety-Critical Roles and Enhanced Medical Standards

> The DC environment has a higher density of safety-critical roles than almost any commercial workplace. Recognising this — and acting on it through appropriate enhanced medical standards — is both a legal obligation and a fundamental duty of care.

A role is classified as safety-critical where sudden incapacitation — from cardiac event, epileptic seizure, loss of consciousness, severe fatigue, or acute mental health crisis — could directly cause death or serious injury to the worker, their colleagues, or the surrounding community. The threshold is not about severity of the hazard in general; it is about the consequence of incapacitation specifically.

The DC environment contains multiple roles meeting this definition that are not typically subjected to enhanced medical standards in practice. The Prime OH Intl. framework defines three enhancement tiers above standard occupational health, each with precise clinical criteria:

Safety-Critical Medical Tier Classification

Group 2 Equivalent — Full DVLA Group 2 (HGV/PCV) standard: vision ≥6/7.5 corrected binocularly, visual fields ≥160°, epilepsy seizure-free 10 years off medication, cardiovascular fitness, diabetes management. Applied to: all forklift and MEWP operators in the DC environment. Frequency: pre-employment + every 3 years under 45; annual at 45+.

Group 2 Modified — Cardiac and epilepsy standards at Group 2 level; full vision field requirement less stringent; specific fitness for arc flash PPE use; colour vision (Ishihara) mandatory; EMF cardiac device screening mandatory under EU Directive 2013/35/EU. Applied to: all HV and live LV electrical workers; emergency response / SCBA team members. Frequency: pre-employment + every 3 years; annual if cardiac risk factors or age >50.

Enhanced OH Standard — Elevated periodic assessment beyond standard OH: specific assessment against the demands of the safety-critical task (height fitness, confined space fitness, SCBA fitness, physical security fitness, NOC sole-responsibility cognitive fitness). Applied to: regular working-at-height roles; confined space permit holders; NOC Shift Leads with sole out-of-hours critical infrastructure responsibility; intervention-trained security. Frequency: pre-employment + annual certification.

The NOC Shift Lead: A Safety-Critical Role Without a Precedent

The most intellectually distinctive safety-critical classification in the DC context is the NOC Shift Lead or Senior DCIM Operator who carries sole responsibility for critical infrastructure during overnight hours. This is not a traditional Group 2 scenario — the risk is not primarily mechanical incapacitation. It is cognitive incapacitation: the risk that a worker with untreated obstructive sleep apnoea, active severe depression, uncontrolled medication effects, or a substance dependency disorder makes a critical infrastructure decision that triggers a cascading failure affecting the thousands or millions of people whose services depend on that facility.

No existing occupational health standard addresses this. The Prime OH Intl. framework requires an annual psychological and sleep screen for sole-responsibility NOC Leads — including ESS (Epworth Sleepiness Scale), PHQ-9, GAD-7, PSQI, and a medication review — combined with a documentary process that communicates the fitness-for-work conclusion to the employer without disclosing clinical detail. This is clinically defensible, legally proportionate, and — currently — unique in the industry.

Legal Defensibility and Equality Law Compliance

The imposition of enhanced medical standards is legally defensible provided three conditions are met: the standard is specifically related to a genuine, identified occupational risk (not a general health requirement); reasonable adjustments have been considered before any fitness-for-work determination is made; and the standard is applied consistently across all workers in equivalent safety-critical roles. Under the Equality Act 2010 (UK), ADA (US), and EU Equal Treatment Directive, an enhanced medical standard that meets these criteria does not constitute disability discrimination — it constitutes proportionate risk management. The occupational health physician must document the justification for each role's classification in a manner that would withstand scrutiny in an employment tribunal or regulatory audit.

SECTION 06

Emerging Technology Hazards: Liquid Cooling, AI Rack Density, and EMF

> The AI-driven transformation of data centre infrastructure is generating new occupational health exposure categories faster than regulatory frameworks or published toxicology can keep pace.

Three technology trends are creating occupational health exposure scenarios for which no established OEL, no published epidemiology, and in some cases no regulatory guidance exists. The precautionary principle is not optional in these circumstances — it is the only clinically defensible position.

Liquid-to-Chip and Immersion Cooling

Liquid-to-chip cooling (also termed direct liquid cooling or direct-to-chip) is now standard in AI-optimised rack deployments. Coolant — typically deionised water, propylene glycol, or a synthetic heat-transfer fluid — circulates through cold plates mounted directly on CPU and GPU packages, returning at 40–60°C. Maintenance operations require direct dermal contact with these fluids under conditions that are inherently awkward given the density of components in a high-GPU rack.

The occupational health concerns are threefold. First, synthetic heat-transfer fluids including polyalkylene glycol (PAG) formulations have limited occupational toxicology characterisation — no long-term inhalation or dermal absorption OEL exists for many currently deployed formulations. Second, manifold fittings disconnected under pressure represent a realistic thermal burn hazard. Third, and most significantly for the longer term: the dielectric fluids used in single-phase immersion cooling (bath-type submersion of entire servers) include engineered fluorinated compounds structurally related to PFAS — per- and polyfluoroalkyl substances. EU REACH is progressively restricting certain PFAS classes, creating a moving regulatory target. Any facility deploying immersion cooling should maintain a dynamic chemical register with SDS reviewed at least annually as formulations change, and implement precautionary dermal protection as a minimum until adequate OEL data exists.

AI Rack Density and the Thermal Paradox Intensified

GPU-optimised racks at 40–100 kW generate localised hot-aisle temperatures that can exceed 50°C in some configurations — 5–10°C above the levels documented in the existing server hall literature. The WBGT monitoring protocols established for conventional DCs must be recalibrated when rack density is upgraded. AI workload patterns also differ from conventional compute: sustained, high-duty-cycle AI training runs maintain maximum thermal output continuously, while conventional workloads have lower average utilisation. For the workers maintaining these environments, this means the thermal exposure during a maintenance event on an active AI training cluster is qualitatively and quantitatively different from historical DC maintenance experience.

Electromagnetic Fields in the AI-Era DC

ELF magnetic fields (generated by high-current busbars, UPS systems, and transformers) and RF-EMF (from Wi-Fi, server management interfaces, and increasingly from base stations co-located on DC roofs) are both classified as IARC Group 2B possible carcinogens. EU Directive 2013/35/EU mandates an occupational EMF risk assessment for all workplaces with significant electromagnetic field exposure. In practice, most DC facilities have not conducted a comprehensive EMF characterisation of their electrical plant environments.

The most clinically urgent EMF issue is not the carcinogenic classification but the cardiac implant interaction risk. Workers with pacemakers or ICDs who perform maintenance work near live HV equipment, large transformers, or UPS systems may experience device inhibition or inappropriate ICD discharge at ELF-MF flux densities that are achievable in proximity to this equipment. This is a known, documented hazard — it is not theoretical — and it requires a formal pre-employment and ongoing assessment process for any worker in Groups D or E who has a cardiac implant. The legal obligation under EU Directive 2013/35/EU is unambiguous.

EMERGING EXPOSURE ACTION CHECKLIST FOR DC OPERATORS

1. Liquid cooling deployed or planned: maintain dynamic chemical register; SDS review annually; precautionary dermal PPE protocol; thermal burn risk assessment for manifold maintenance; PFAS transition plan as EU REACH restrictions evolve.

2. AI rack upgrade (rack density >30 kW): recalibrate WBGT monitoring; revise hot-aisle maintenance access protocols; update heat illness susceptibility questionnaire triggers; review hydration station locations.

3. EMF: commission site-level EMF characterisation (occupational hygienist with IEC 62110 competence); implement cardiac implant screening protocol for Groups D and E; document compliance with EU Dir. 2013/35/EU for all facilities with EU jurisdiction.

SECTION 07

Regulatory Gaps and the Case for a DC Worker Cohort Study

> The occupational health regulatory landscape has not kept pace with the growth, complexity, or hazard profile of the data centre industry. These gaps represent both a clinical risk and a liability risk for operators.

The current regulatory framework governing DC occupational and environmental health is a patchwork of general industry standards — noise regulations, COSHH, manual handling, DSE, Legionella codes of practice — applied to an environment for which none of them were designed. Four critical regulatory gaps are identified by Prime OH Intl. as priority areas for industry-led action:

Gap 1: No DC-Specific Occupational Health Standard

No jurisdiction has published a DC-specific occupational health standard analogous to the sector-specific guidance that exists for the offshore oil and gas industry, the healthcare sector, or the mining industry. The consequence is that DC operators have no clear regulatory benchmark for compliance, and OH practitioners working in this sector have no authoritative clinical reference. The Prime OH Intl. framework represents the first attempt to fill this gap.

Gap 2: Community Consequence Assessment for Electrical Failures

No jurisdiction currently mandates that a DC operator demonstrate, as part of the planning or environmental impact assessment process, that a credible worst-case electrical failure would not cause harm to persons or property outside the site boundary. The arc flash and transformer fire scenarios described in Section 02 of this whitepaper represent genuine community-level risks that are absent from all current regulatory requirements. The precedent from the nuclear and chemical industries — where consequence assessment beyond the fence line is standard — has not been applied to data centres despite comparable potential for catastrophic external impact.

Gap 3: DC Immersion Cooling and Novel Fluid Regulation

The dielectric and heat-transfer fluids deployed in liquid-to-chip and immersion cooling systems are proliferating faster than regulatory toxicology can characterise them. Several fluorinated compounds previously used as immersion cooling fluids are now restricted under EU REACH PFAS provisions. New formulations entering the market may not have adequate occupational toxicological characterisation at the time of commercial deployment. A sector-wide commitment to proactive OEL development — through collaboration between DC operators, fluid manufacturers, and occupational toxicologists — is needed.

Gap 4: The Absence of a DC Worker Cohort Study

Perhaps the most significant scientific gap in the field is this: no published prospective epidemiological cohort study exists for data centre workers as a defined occupational population. All evidence cited in this whitepaper — and in the broader literature — is derived from comparable industrial exposures in other sectors. The DC workforce has unique characteristics that may modulate risk in ways that single-hazard studies in other industries cannot capture: the simultaneous co-exposure to multiple IARC-classified agents; the specific cold-hot thermal cycling that is unique to this environment; and the combination of shift work-induced immune suppression with concurrent carcinogenic chemical exposures.

Prime OH Intl. advocates for the establishment of a multicentre prospective occupational cohort study of DC workers, following the precedent of the Diesel Exhaust in Miners Study (DEMS, NCI/NIOSH) and the Nurses Health Study (for shift work). The minimum dataset would encompass: pre-employment baseline audiometry, spirometry, and biomarker panels; annual health outcomes surveillance; personal exposure quantification for noise, chemicals (including novel cooling fluids), thermal environments, and EMF; and linkage to national cancer registries with a minimum 20-year follow-up. Without this evidence base, the health of the DC workforce will continue to be managed by inference rather than evidence — and the regulatory frameworks that protect that workforce will remain perpetually behind the technology they are meant to govern.

Gap 5: The Community Health Dimension — A Proposed Solution

Beyond the occupational health of the workforce inside the facility, a fifth and rapidly emerging regulatory gap concerns the health of the communities around it. Peer-reviewed research published in 2024 and 2025 has established that data centres are disproportionately located in communities that already carry elevated environmental burdens — poor ambient air quality, groundwater stress, and high concentrations of hazardous waste sites — creating a compound environmental justice exposure for the populations living within operational proximity of major DC clusters. Diesel exhaust plumes from extended generator operation, cooling tower Legionella drift at community receptor points, low-frequency noise at residential boundaries, and PFAS contamination risk from immersion cooling facilities are all documented or plausible community health pathways that no existing planning, environmental impact assessment, or ESG disclosure framework addresses with clinical specificity. Prime OH Intl. proposes the development of a **DC Community Health Impact Assessment (DC-CHIA)** standard — a governance framework that extends the occupational health duty of care beyond the site perimeter, covering five domains: air quality and diesel dispersion modelling; noise impact on residential receptors; water withdrawal and chemical discharge; environmental justice profiling of adjacent communities against US EPA EJScreen and EU Just Transition criteria; and emergency health consequence planning for worst-case electrical, chemical, and biological events with defined community evacuation zones. The DC-CHIA is directly anchored to existing and incoming legal obligations — the EU CSRD mandatory sustainability reporting (effective 2025–2026), the EU Environmental Impact Assessment Directive, GRI Standard 413 (Local Communities), and the SEC climate disclosure framework in the United States. Unlike the technical assessments produced by environmental consultancies or the disclosure templates provided by ESG advisors, the DC-CHIA integrates clinical health outcome quantification — IARC-based dose-response modelling, community Legionella risk, noise-induced cardiovascular morbidity — with governance and mandatory reporting, providing a level of clinical rigour that no other framework currently offers. Prime OH Intl. will publish the full DC-CHIA position paper in Q2 2026. It represents the logical and necessary extension of the internal workforce health framework described throughout this whitepaper: from the worker at the rack, to the engineer on the roof, to the family living two streets from the fence line.

> ***"We are investing trillions of dollars in the infrastructure of artificial intelligence. We are investing almost nothing in understanding what that infrastructure costs the people who build and maintain it."***

PRIME OH INTERNATIONAL — DC OCCUPATIONAL HEALTH RESEARCH ADVOCACY POSITION, 2026

SECTION 08

The Prime OH Intl. DC Framework: A Complete Governance Solution

> Eight years of direct clinical experience in DC occupational health governance, synthesised into a deployable framework that any DC operator can implement — regardless of facility size, geography, or technology generation.

The Prime OH Intl. DC Occupational Health Framework was initiated in 2018 with a hyperscale data centre giga-project and has since been developed and refined across DC environments in Europe, the Middle East, and Asia-Pacific. It is the only framework of its kind globally that addresses the full 360° risk profile of the DC environment — from pre-employment medical standards to emergency evacuation planning, from diesel exhaust biological monitoring to liquid cooling fluid SDS governance.

Framework Components

360° Risk Management Roadmap

DC-OH-RMR-001. 16 sections covering all physical, chemical, biological, psychosocial, and environmental hazards. 18 critical gaps identified beyond standard industry frameworks.

Medical Surveillance Programme

DC-OH-MSP-001. 28-page clinical protocol. Role-specific tests, frequencies, action thresholds, referral pathways, and fitness-for-work criteria for all 8 role groups.

DC Job Roles Directory

204 roles across 18 functional areas with OH risk exposure mapping against 19 hazard categories.

Surveillance Cross-Reference Tool

DC-OH-CRT-001. Filterable by role group, hazard, and Mandatory/Best Practice classification. Periodicity matrix, safety-critical tier system, and surveillance intensity ranking.

Emergency Evacuation Plan

Interactive floor-by-floor evacuation plan covering 4 levels, 8 emergency scenarios (fire, gas, power loss, security, chemical, medical, mobility-impaired, contractors), warden assignments, and DC-specific hazard protocols.

Pre-Employment Assessment Forms

Role group-specific pre-employment health assessment forms with Group 2, Group 2 Modified, and Enhanced OH clinical criteria embedded.

Implementation Approach

The Prime OH Intl. framework is designed for on-site implementation — not remote advisory. Direct facility survey and workforce engagement are non-negotiable components of any serious DC occupational health programme. The framework can be deployed in phases: a rapid regulatory compliance audit against mandatory surveillance obligations (typically 6–8 weeks); a full risk management roadmap implementation with tailored surveillance programme (3–6 months); and ongoing clinical oversight as a retained occupational health partner.

The framework is jurisdiction-adaptable. The clinical standards are anchored to international best practice (IARC, WHO, ICNIRP, IEA), but the legal compliance layer is mapped to the specific regulatory requirements of each operating jurisdiction — EU, UK, US, UAE, Singapore, or any other. Multilingual clinical delivery is available.

SELECTED REFERENCES

1. International Energy Agency. *Energy and AI*. Paris: IEA, 2025.
2. IARC Monographs Vol. 124. *Night Shift Work*. Lyon: IARC/WHO, 2020. PMID:33656825
3. IARC Monographs Vol. 105. *Diesel and Gasoline Engine Exhausts and Some Nitroarenes*. Lyon: IARC/WHO, 2013.
4. Vermeulen R et al. "Exposure-response estimates for diesel engine exhaust and lung cancer mortality." *Environ. Health Perspect.* 2014;122(2):172–177. DOI:10.1289/ehp.1306880
5. Erren TC, Morfeld P. "Night shift work and breast cancer risk: systematic review and meta-analysis." *Ann. Work Expo. Health*. 2023. DOI:10.1093/annweh/wxad051
6. Woods V. "Musculoskeletal disorders and visual strain in intensive data processing workers." *Occup. Med.* 2005;55(2):121–127. DOI:10.1093/occmed/kqi029
7. Alnuaimy A, Shushura O. "Impact of Noise Inside Server Room." *CEUR-WS* Vol.3149, Paper 2. Kyiv, 2022.
8. Marinaccio A et al. "Occupational heat stress, heat-related effects and the related social and economic loss." *Front. Public Health*. 2023;11. PMC10434255
9. Chapman CL et al. "Occupational heat exposure and the risk of chronic kidney disease." *Am. J. Physiol.* 2021;321(2):R141–R151. DOI:10.1152/ajpregu.00103.2021
10. IARC Monographs Vol. 80. *Non-ionizing Radiation, Part 1: Static and ELF Electric and Magnetic Fields*. Lyon: IARC, 2002.
11. ICNIRP. "Guidelines for limiting exposure to electromagnetic fields (100 kHz to 300 GHz)." *Health Physics*. 2020;118(5):483–524.
12. European Parliament. Directive 2013/35/EU on occupational exposure to electromagnetic fields. Official Journal of the EU, 2013.
13. de Vries-Gao A. "The carbon and water footprints of data centres." *Patterns*. 2025. DOI:10.1016/j.patter.2025.101296
14. Xiao T et al. "Environmental impact and net-zero pathways for AI servers in the USA." *Nature Sustainability*. 2025. DOI:10.1038/s41893-025-01681-y
15. Lawrence Berkeley National Laboratory. *2024 United States Data Center Energy Usage Report*. December 2024.
16. de Looze MP et al. "Exoskeletons for industrial application and their potential effects on physical work load." *Ergonomics*. 2016;59(5):671–681.
17. IEEE Std 1584-2018. *Guide for Performing Arc Flash Hazard Calculations*. New York: IEEE, 2018.

18. OSHA. Legionellosis — Hazards, Control and Prevention. osha.gov/legionnaires-disease
19. CDC/NIOSH. Occupational Hearing Loss. cdc.gov/niosh/noise (accessed March 2026)
20. EU REACH Regulation — Restriction on PFAS. ECHA, 2023. echa.europa.eu

Commission Your DC Occupational Health Framework

Prime OH Intl. provides on-site occupational health governance for data centre operators, hyperscalers, and colocation providers globally — from regulatory compliance audit to full framework implementation and retained clinical oversight.

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