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RESPIRABLE CRYSTALLINE SILICA IN THE RAIL SECTOR

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Summary	This RIG advises ORR inspecting staff on the legal framework and action to take in securing compliance with the Control of Substances Hazardous to Health Regulations (COSHH) for exposures to respirable crystalline silica in railway settings, including rail ballast handling, track renewals, and property maintenance and refurbishment tasks.
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Detail

Introduction

1 Occupational exposure to respirable crystalline silica (RCS) is a major cause of lung disease, including silicosis, chronic obstructive pulmonary disease (COPD) and lung cancer, and has also been linked to kidney disease, and arthritis. ORR has identified long latency occupational lung disease, including exposure to RCS, as a priority in our strategic risk chapter on occupational health[1].

2 This internal ORR guidance captures key findings from our inspection and engagement with the rail industry on RCS management, and signposts inspecting staff to further information. It focuses mainly on those processes unique to the rail industry, namely mechanised ballast handling at ballast stock piles/aggregate handling depots (AHDs) and during track renewals. However, the same principles of risk management apply to other rail work activities where RCS exposure is foreseeable, including construction type tasks in property/infrastructure maintenance and refurbishment.

Key principles

3 A summary of the key principles underpinning the detailed operational guidance:

- The RCS Workplace Exposure Limit (WEL) is not a safe level. Where exposure cannot be prevented it must be adequately controlled. COSHH requires a high standard of control for RCS: the WEL must not be exceeded and the principles of good control practice in COSHH Schedule 2A applied, with exposures reduced proportionate to the serious health risk presented.

- Exposures to RCS during common rail industry tasks, including track renewals and building/infrastructure maintenance, can be highly variable and heavily influenced by the weather, ballast/material quality, task duration, and site controls. COSHH risk assessments should reflect the known range of likely exposures rather than place undue reliance on individual RCS exposure monitoring results.

- Industry experience clearly shows the potential for very significant RCS exposures at or exceeding the WEL during mechanised track renewals, and for construction type tasks involving use of high energy power tools on common building materials such as stone, brick, concrete, tiles, and cement/mortar.

- New ballast handling machinery and plant should be designed and equipped with dust controls such as water suppression and exhaust

[1] https://www.orr.gov.uk/sites/default/files/om/safety-stratandegy-chapter-9.pdf

ventilation. For existing equipment, retrofitting of integral dust controls (e.g. protected operator cabs and fixed water sprays) or provision of stand-alone dust suppression measures (e.g. mobile spray systems) should be properly considered as part of any recertification risk assessment and product acceptance processes.

- Respiratory Protective Equipment (RPE) should be used as a last resort in conjunction with other controls, rather than as the default option. For RCS a minimum assigned protection factor (APF) of 20 is required, with tight fitting RPE face fit tested to the individual and workers clean shaven. Where workers need to wear RPE without a break for more than an hour, a powered filtering respirator should be used rather than tight fitting type.

- Adequate washing and welfare facilities, including areas for eating, drinking, and smoking away from the higher risk tasks or areas of the work site should be provided and used.

- Inspectors should focus on ensuring that exposure to RCS is minimised (i.e. that adequate risk controls and underlying management arrangements are in place). Health surveillance is never a substitute for controls to minimise worker exposure but has an important role in protecting employee health.

- When considering enforcement, prioritise those measures which have the greatest impact on reducing worker RCS exposures, particularly engineering dust controls, systems and methods of work, suitable RPE and hygiene measures.

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Relevant legal requirements

5 RCS is classed as a substance hazardous to health under The Control

of Substances Hazardous to Health Regulations 2002 (as amended)[2] (COSHH) with a WEL of 0.1 mg/m^3 8-hour Time Weighted Average (TWA). Even at an exposure of half the WEL, for a 45-year working life-time there is an estimated risk of 1 in 20 of developing silicosis[3]. RCS is recognised as a 'definite' human carcinogen for lung cancer by the International Agency for Research on Cancer and, from January 2020, a carcinogen notation (indicating a substance capable of causing cancer) for process generated RCS was added to HSE publication EH40[4].

6 Given the serious health risk, employers are required to apply a proportionately high and rigorous standard of control as well as reducing exposure below the WEL. COSHH Regulation 7 requires exposure to process generated RCS to be prevented, or where this is not reasonably practicable, adequately controlled. RCS control will only be deemed adequate if the WEL is not exceeded and the principles of good control practice in Schedule 2A to COSHH are applied. RCS exposures should be reduced to as low as is reasonably practicable, until the cost becomes grossly disproportionate compared with the additional benefit gained.

7 Additional requirements for the control of carcinogens[5] in Regulation 7(5) apply in every circumstance to process generated RCS. Guidance on a proportionate approach to regulation and enforcement of the requirements of Regulation 7(5) when they are relevant, is discussed further in paragraphs 56-58

8 Plant and equipment suppliers have duties under Section 6 of the Health and Safety at Work Act 1974, and under the Supply of Machinery (Safety) Regulations 1992 as amended[6] to design and construct their products to minimise risks from exposure to hazardous substances, including RCS. Rail employers need to consider the design and procurement of suitable plant and equipment to minimise worker exposure to RCS. Where employers share a workplace, for example a renewals site, the duty to co-operate under Regulation 11 of the Management of Health, Safety at Work Regulations 1999 also applies.

Assessing RCS exposure: COSHH Regulation 6

9 COSHH Regulation 6 requires railway employers to carry out a

[2] https://www.legislation.gov.uk/uksi/2002/2677/regulation/7/made
[3] https://www.hse.gov.uk/foi/internalops/og/og-00017.pdf
[4] https://www.hse.gov.uk/pubns/books/eh40.htm
[5] Whilst RCS is a recognised carcinogen with a 'Carc' notation in EH40, it is not listed in COSHH Schedule 1 and does not have a harmonised classification of carcinogenicity under the Chemical (Hazard Information and Packaging for Supply) Regulations 2009 (CHIP). However, as a substance which, if it were to be classified under CHIP would be a category 1 or 2 carcinogen (whether or not that substance is actually required to be classified under CHIP) it would meet the definition of a carcinogen under COSHH.
[6] https://www.legislation.gov.uk/uksi/1992/3073/made

suitable and sufficient assessment of the risks from exposure to RCS arising from their work. Rail employers and workers may not always recognise that the RCS WEL of 0.1mg/m^3 is 40 times lower than the 4mg/m^3 exposure level for general respirable dust specified under COSHH. As respirable silica dust cannot easily be seen under normal lighting conditions, the absence of a visible dust cloud is not always a reliable indicator that control is adequate. However, if the larger airborne dust particles are clearly visible this suggests that control of the smaller respirable fraction may be inadequate. Further guidance for rail employers on the procurement of occupational hygiene services for RCS exposure monitoring and analysis is available in a research report produced by HSL for RSSB[7].

10 The silica content in common building materials and rail ballast is variable but can be significant: typical estimates are sandstone (70-90%); concrete and mortar (25-70%); tile (30-45%); granite ballast (20-45%); and brick (up to 30%). It may not always be straightforward to estimate the silica content for a specific material, as ballast may come from more than one quarry and/or AHD, and so the risk assessment should apply a precautionary approach using the high end of known silica content unless there is good evidence otherwise.

11 **Risk assessment for ballast handling:** The mainline Ballast Dust Working Group (BDWG)[8] has driven significant improvement in the assessment and control of process generated RCS from ballast handling activities. Sharing of RCS exposure monitoring data by BDWG members has resulted in a better (although not complete) understanding of the potential risk from specific ballast handling tasks.

12 Exposure monitoring data for mainline mechanised track renewals activity show that RCS exposures for the same task can be highly variable, and are heavily influenced by the weather, as well as by ballast quality, task duration, engineering controls, working methods, and possibly individual behaviour. Extensive monitoring data show RCS exposures for the same type of task varying from less than one third of the WEL to significantly above the WEL, particularly on longer (e.g. 10+ hour) conventional track renewals shifts (up to 3 x WEL) and also for renewals work in tunnels (up to 5 x WEL).

13 Based on the evidence from mainline RCS exposure monitoring data, the number of variables potentially affecting worker exposure, and applying the required precautionary approach under COSHH, we consider very significant exposure to RCS during mechanised track renewals to be reasonably foreseeable. Higher risk tasks are likely to include all external positions (operators, technical, and supervisory) alongside Network Rail's High Output Track Renewal (HOTR) machines

[7] https://www.rssb.co.uk/en/what-we-do/key-industry-topics/health-and-wellbeing/health-hazards/Silica-dust-is-a-railway-health-hazard
[8] https://safety.networkrail.co.uk/safety/ballast-dust-working-group/

including Ballast Cleaning Systems (BCS) and Track Relaying Systems (TRS). On conventional track renewals sites, higher risk tasks are likely to include the operation of autoballasters, ballast regulators, triple wackers, ballast brushes/mechanical re-profilers and use of road rail vehicles/dozers/excavators. Without the provision of effective dust controls in vehicle cabs and the direct suppression of ballast dust on conventional renewals sites, particularly in dry conditions, there is the potential for very significant exposures to operators and machine controllers. Mechanised ballast handling in areas of restricted natural ventilation such as in tunnels, steep cuttings, or under enclosed station canopies, are also likely to be higher risk, depending on task duration.

14 Industry data on typical RCS exposures from use of tampers, dynamic track stabilisers, and stone blowers is currently limited but suggests a moderate rather than high risk. Exposure monitoring data for manual ballast handling tasks carried out by Network Rail maintenance and works delivery teams is currently limited but suggests that short duration tasks such as manual digging and repacking of rail joints, manual ballast brushing/reprofiling, and wet bed removal are likely to be lower risk. There remain gaps in understanding the extent of risk from secondary exposures by workers disturbing settled dust in machine cabs during cleaning and maintenance tasks on ballast handling equipment. Additional exposure monitoring data is needed in these areas to inform the COSHH assessment and demonstrate the adequacy of existing controls.

15 A technical review by HSL of industry RCS exposure monitoring data for railway ballast handling activities[9] concluded that bulk ballast loading/unloading operations at Network Rail AHDs are lower risk if the existing dust controls are properly used and maintained, with regular (e.g. two yearly) assurance monitoring recommended.

16 **Risk assessments for non-ballast handling activities**: The potential for significant RCS exposures in other rail activities should not be overlooked. Rail workers can be exposed to RCS when carrying out construction type tasks during maintenance work both on and off track, e.g. cutting of concrete troughing or paving; property or bridge maintenance and refurbishment work; manual breaking out of concrete chairs, pit blocks or sleepers on sub-surface lines.

17 Experience from the construction industry suggests that tasks involving cutting, chasing, drilling, grinding, and blasting of concrete, stone, aggregate, brick, tiles, or cement/mortar, as well as extensive/regular dry sweeping in enclosed locations, can potentially expose workers to high silica dust levels, significantly in excess of the

[9] https://www.rssb.co.uk/what-we-do/key-industry-topics/health-and-wellbeing/health-hazards/Silica-dust-is-a-railway-health-hazard

WEL. HSE operational guidance on construction dust includes advice on common higher risk RCS tasks.[10]

18 Other rail industry tasks with potential for RCS exposure include the cleaning and grinding of sand-based mould residue following aluminothermic rail welding, and filling/cleaning of rolling stock sanding equipment. Current knowledge suggests that these are likely to be lower risk activities. Limited exposure monitoring data available for dust and fume in cleaning and grinding of rail welds suggests low RCS exposures, but with evidence of elevated levels of inhalable and respirable dust (from grinding) and of some gaseous components including nitrous oxides.

Prevention and control of RCS exposure: COSHH Regulation 7

19 The RCS WEL is not a 'safe' level and ill health effects can still occur below it. Where prevention, preferably by means of elimination or substitution, is not reasonably practicable, adequate control should be achieved using the hierarchy of control measures specified in COSHH regulation 7(3) in the priority order stated. Inspectors should look for a planned programme of short and longer-term measures to manage RCS exposure, which include consideration of all the control measures set out below:

20 **Elimination COSHH Regulation 7(1)**: Inspectors should reinforce the importance of health by design in driving improved management of RCS exposure. With current technology and infrastructure processes, the complete elimination of ballast dust is not reasonably practicable, however consideration of health by design principles to minimise RCS exposure should be included in the design and procurement of new plant and equipment.

21 **Design standards**: Existing standard BS EN 14033-3:2009 for rail bound construction and maintenance machines requires new ballast handling on-track machines (OTMs) to be equipped with dust suppression (e.g. water sprays, vacuum systems) and operator cabs to be fitted with particle filters to prevent dust ingress. Operator cabs on Network Rail's BCS 3 and 4 machines have been retrofitted with forced air ventilation, with the newer BCS5 machine fitted from new. Further improvement to the existing liquid dust suppression on the BCS machines is scheduled for completion in 2022. Cabs on the TRS 2 and 4 machines are protected from dust ingress, with the addition of water based dust control to the D75 ballast cleaner units planned for completion in 2021/22.

22 Changes in 2018 to Network Rail's Infrastructure Plant Manual (IPM) NR/L2/RMVP/0200 Issue 10 introduced a requirement for control of RCS dust on all new on-track plant (OTP) capable of being used for

[10] https://www.hse.gov.uk/foi/nternalops/og/og-00017.pdf

ballast handling, including road rail vehicles (RRVs) and ballast handling attachments. IPM Module P102 now mandates the consideration of occupational health hazards in the risk assessment and the application of the hierarchy of control. IPM Module P300 requires the provision of engineering control for respiratory risks, particularly RCS, for OTM, OTP and mobile and portable plant. This change applies to new OTP for use on Network Rail infrastructure, and for existing OTP via the 7 yearly re-certification process**.** These changes to Network Rail design standards are expected to be considered as part of the revision to RIS-1530-PLT Technical Requirements for On-track plant and their associated equipment and trolleys in due course.

23 To support this new requirement Network Rail commissioned research and field trials to inform draft design specifications for liquid suppression and vacuum/extraction dust control systems for use by OTP users, suppliers, and plant acceptance bodies. For new/recertified OTP, Network Rail expects suppliers' risk assessments to identify appropriate RCS controls, including integral and stand-alone dust suppression measures. Stand-alone dust suppression systems (water dousing, sprays or misting) may be suitable for multi-purpose RRVs not dedicated to ballast handling tasks. Where no RCS control measures are included in the product acceptance submission for initial approval or recertification, the expectation is that the OTP would not be approved for use with ballast.

24 **Substitution COSHH Regulation 7(2):** Depending on the nature and duration of the work reasonably practicable solutions may include: replacing use of triple wackers with compaction rollers to consolidate the ballast in conventional track renewals; replacing manual breakers with remote control breakers, or use of hydraulic concrete bursting techniques to break up concrete pit blocks and sleepers on sub-surface lines; substituting lineside concrete troughing for plastic composite troughing (reducing both manual handling and RCS exposure risks), or cutting concrete troughing to size under controlled conditions off site.

25 **Engineering control COSHH Regulation 7(3a):** Systems to reduce and dampen dust in the ballast before it leaves for the worksite should now be standard on mainline infrastructure and include: screening and water spray systems at the quarries (including a new rinsing plant at Barrow-on-Soar loading point brought on-stream in 2020); spraying of ballast stockpiles and during ballast loading using either static gantries or mobile tractors and bowsers at AHDs, and 'monsoon simulator' spray systems at Network Rail High Output Operating Bases (HOOBs).

26 Engineering control of RCS on work sites is more challenging but recent years have seen some major improvements in provision. Network Rail's HOTR BCS fleet now has positive pressure systems fitted to operator cabs to prevent dust ingress, and water spray systems on the RM900 ballast cleaner at the cutter bar, ballast screens and clamp 2 ballast delivery area. On the TRS 2 and 4 machines the D75 ballast

cleaner units also have positive pressure cabs, with plans for water based dust suppression to be fitted at the cutter bar and ballast hopper distribution positions on both machines during 2021/22.

27 Network Rail's CP6 capital programme for OTMs includes retrofitting liquid dust suppression to its autoballaster and side tipper fleets, with field trials and testing advanced. Work is also ongoing to assess the impact on the friction, stability and drainage characteristics of ballast treated with liquid dust stabilisers applied directly to ballast to suppress the release of fine dust. The impact of additives used in conjunction with water misting systems to reduce surface tension and attract fine particulates is being similarly assessed.

28 Network Rail funded research and field testing for dust control on conventional renewals tasks concluded that exhaust ventilation systems are most effective for control of RCS in enclosed locations such as tunnels, but that for open track working liquid dust suppression is most effective. Dousing of open ballast wagons and/or the track bed with large droplets several minutes prior to disturbance is judged most effective. Stand-alone mobile water spray or misting systems positioned between on-track plant activity and workers can reduce RCS significantly but have limited range (approximately 20m) and are weather dependent (particularly wind strength and direction). Innovations in the design of high-pressure nozzles to deliver a fine aerosol significantly reduces the volume of water required, meaning that use of water spray systems to dampen dust should increasingly become reasonably practicable out on track. In locations with limited space contractors have trialled the use of misting systems as part of the link lighting in the cess. Network Rail Route Services are looking at practical methods of cleaning ballast wagons to prevent accumulation of fines at the base; and mobile ballast washing at AHDs.

29 On its surface line infrastructure, LUL has used suction/vacuum extraction methods to remove old ballast in suitable locations, and where this is not possible, pre-application of binding agents prior to ballast removal can significantly reduce the generation of dust. Dust from depositing new ballast is minimised by extensive damping prior to unloading, and the routine practice of maintaining low drop heights from excavator buckets.

30 Engineering controls for common construction and maintenance type tasks are well established. These include use of on tool extraction for portable equipment; water sprays to suppress the dust; suitable vacuum cleaners (M or H type) rather than dry sweeping; in conjunction with suitable RPE for higher risk tasks. Existing HSE good practice guidance on control of dust in construction tasks[11]can be applied to the rail sector,

[11] https://www.hse.gov.uk/construction/healthrisks/hazardous-substances/construction-dust-specific-tasks.htm

for example during property maintenance and refurbishment. Guidance for EU regulators[12] on expectations for RCS control for common construction tasks should also be useful to inspectors. This guidance includes risk control sheets specific to common construction tasks, such as cutting concrete blocks/paving outdoors, chasing out brickwork, and dry sweeping indoors, and provides clear information on the level of control expected.

31 **Organisational control COSHH Regulation 7(3b)**: RCS exposures can be reduced by organisational controls upstream of the worksite including supplier quality assurance, testing and audits at quarries and AHD ballast stockpiles; ballast stockpile management to minimise accumulation of fines at the base; and prompt reporting and investigation of ballast quality issues/complaints. Better planning of ballast delivery can help to minimise drying out of pre-wetted ballast wagons stabled prior to a job, as well as avoiding 'topping up' part loaded ballast wagons.

32 On renewals sites key procedural controls include minimising excavator bucket drop heights for ballast unloading; keeping non-essential workers clear of dusty areas by enforcing exclusion zones; keeping machine cab doors and windows closed (which requires effective communication systems between those inside and outside the cabs); regular cleaning of machine cabs and other work areas using a class M or higher vacuum if possible, or alternatively wet wiping (not dry brushing).

33 In addition to the engineering controls on its HOTR BCS and TRS machines, NR has mandated a dust management zone (DMZ) of 100m around the operating footprint of the OTMs during operation and for one hour after OTM works cease. All staff within the DMZ are required to carry suitable RPE (including being trained, face fit tested, and clean shaven) and wear it when instructed to do so. Tasks within the DMZ should be identified when planning and ordering resource; included in Safe Work Packs; the correct RPE checked by Site Access Controllers; and its use use enforced by the Person in Charge. Network Rail is looking at whether further detailed exposure monitoring data supports any change to the extent and/or duration of the DMZ (including the impact of rain and dust settlement times) in order to support better behavioural compliance around RPE use within the DMZ.

34 **Personal Protective Equipment (PPE) COSHH Regulation 7(3c):** HSE guidance on selection, use and maintenance of respiratory protective equipment[13] applies to the rail industry. RPE should be the last resort, used in conjunction with other controls, rather than the default option. For most rail industry tasks involving exposure to RCS,

[12] https://osha.europa.eu/en/guidance-national-labour-inspectors-on-addressing-risks-from-worker-exposure-to-respirable-crystalline-silica
[13] https://www.hse.gov.uk/pubns/books/hsg53.htm

RPE with a minimum APF of 20 will be needed, for example FFP3 respirators. For dry work on materials with a high silica content using powered tools in a poorly ventilated area an APF of 40 is recommended.

35 Tight fitting RPE should be face fit tested for the individual, with written records kept, and workers clean-shaven: BS EN 529:2005 on respiratory protective devices provides a reference for unshaven as being more than 8 hours prior to the work starting. A face fit test should be repeated whenever there is a change to the RPE type, model, or a change to the wearer that could affect the fit. Where there are good reasons for having a beard (e.g. religious belief) or an adequate face fit cannot be achieved for other reasons (e.g. facial shape or scarring) loose fitting type RPE (powered hood or helmet for example) may be needed. A pre-use wearer-seal check should be carried out each time a fit-tested face piece is worn[14]. Where workers need to wear RPE continuously for more than an hour, use of a powered respirator (e.g. hood or helmet type) will be needed rather than tight fitting disposable types, as the face seal may not be sufficiently reliable after prolonged use.

36 Network Rail has mandated the use of powered filtering RPE for all machine operators and those working alongside BCS and the D75 ballast cleaner on the TRS 2 and 4 machines. The use of tight fitting FFP3 standard RPE (mainly disposable types) on conventional track renewals sites has improved significantly, but ensuring that track workers are clean shaven remains a challenge. On conventional renewals sites, workers wearing tight fitting RPE should routinely be asked to show RPE to FFP3 standard and checks made that they are clean-shaven as part of the site access control safety briefing conversation. Non-compliances with mandated RPE policies should be reported and investigated to support consistent compliance.

37 Lack of compatibility between RPE and other protective equipment (e.g. safety glasses) and with radio communications equipment, particularly use of boom mikes, is recognised as a potential challenge on renewals sites. The use of throat mikes as an alternative to boom mikes, or powered RPE with an integral microphone and head torch have been successfully used on HOTR sites.

38 **Hygiene measures: COSHH Regulations 7(4e) and 7(5):** Suitable arrangements should be made for workers to access adequate washing and welfare facilities. Designated areas for eating, drinking, and smoking away from the higher risk tasks or areas of the work site should be clearly identified in the risk assessment, be accessible to, and used by, staff.

39 Secondary exposure to RCS from disturbing any settled dust on work wear and in vehicles/cabs should be minimised so far as is reasonably

[14] https://www.hse.gov.uk/peffubns/indg479.pdf

practicable by good housekeeping. Machine cabs and company vehicles should be cleaned using vacuum or wet methods to minimise accumulation of dust, with written records kept. Regular laundering of operators' overalls will also minimise secondary exposure. Use of disposable (high visibility orange) overalls has been trialled as good practice on some higher risk jobs but these may not prove cost effective in all cases. As a minimum, adequate procedures and instructions to workers on how to remove, store, and launder contaminated overalls should be in place to minimise secondary RCS exposures.

Use and maintenance of controls: COSHH Regulations 8 and 9

40 Ensuring that RCS controls are properly used remains a challenge, particularly on multi-contractor work sites where robust supervision is essential. Regulation 9 requires all engineering controls for RCS to be subject to planned preventive maintenance to ensure that they continue to work effectively, and records kept to support monitoring and assurance. Examples include maintenance of cab door/window seals; spray heads/nozzles and pumps on water spray systems; on-tool extraction units; dust filters in vehicle cabs and class M or H vacuum cleaners; and general ventilation fans for work in enclosed areas. Local exhaust ventilation (LEV) requires thorough examination and testing every 14 months, with written records kept. We also expect to see evidence of interim checks to ensure continued control.

41 Effective maintenance is also important for those processes and equipment which indirectly affect RCS exposures, for example communications equipment used by machine operators (so that there is no need to open doors/windows); maintenance of ballast stock piles in AHDs to clear accumulation of fines from the base; and periodic draining of lagoons used for ballast wetting.

42 All RPE should be checked before each use and (except for single use disposable types) be subject to thorough maintenance, examination, and test at least once a month, with written records kept. For RPE used only occasionally every three months should be adequate, in addition to pre-use checks. More detailed advice is on HSE's web site[15].

Exposure monitoring: COSHH Regulation 10

43 While exposure monitoring data has an important role in identifying higher risk tasks, and assessing the impact of enhanced controls, employers should not give undue weight to individual RCS sampling results in implementing the necessary preventive and protective measures. Exposure monitoring data can be used to inform judgements on the adequacy of control against the COSHH benchmark which

[15] https://www.hse.gov.uk/respiratory-protective-equipment/faq.htm

requires exposures consistently below the WEL *and reduced to as low as is reasonably practicable (ALARP)*, rather than to below 50% WEL which has been regarded by some rail duty holders as 'adequate' for COSHH compliance.

44 Network Rail has delivered a programme of regular RCS exposure monitoring for its HOTR operations in recent years, following retro-fitment of improved dust controls and introduction of newer machines such as BCS5 . A similar co-ordinated programme of RCS exposure monitoring for mainline conventional renewals has been less evident and has been further impacted by the devolution of responsibility from Infrastructure Projects function to Capital Delivery within regions. A plan to deliver RCS exposure monitoring for Network Rail's conventional renewal activity merits further attention as the extent of exposure and effectiveness of improved risk controls are still not well understood.

45 Those mainline conventional renewals contractors who have carried out RCS exposure monitoring are encouraged to share suitably anonymised RCS exposure monitoring data with the BDWG to provide the widest pool of data to inform risk assessment and control. Recording the working conditions at the time, particularly the weather (rain, wind direction and strength) and the task duration, will help in assessing whether the RCS sampling results are representative of 'typical' exposures. Further good practice guidance on the requirements for RCS sampling and analysis, and on the additional information needed to put the sampling results into proper context, can be found in the RSSB report on the technical review of BDWG exposure monitoring data[16].

46 Exposure monitoring for RCS during common construction type tasks in rail property maintenance and refurbishment should not be necessary solely in order to demonstrate risk, as the potential for RCS exposures above the WEL is clearly established. Rather, exposure monitoring for construction type tasks should focus on demonstrating the effectiveness of the control measures.

Health surveillance: COSHH Regulation 11

47 Regulation 11 of COSHH requires that 'where it is appropriate' employees be placed under suitable health surveillance to allow early identification of any adverse health effects from a substance hazardous to health and to prompt a review of the adequacy of existing control measures. The decision as to whether health surveillance is appropriate is informed by three criteria: is there an identifiable disease related to exposure; is there a reasonable likelihood of the disease occurring under the particular conditions of work; and are there valid (and low risk) techniques for detecting the disease. For RCS, the evidence on risk of disease (silicosis, COPD and lung cancer) is established; and there are

[16] https://www.rssb.co.uk/what-we-do/key-industry-topics/health-and-wellbeing/health-hazards/Silica-dust-is-a-railway-health-hazard

valid disease detection techniques including lung function testing for COPD and chest x-rays for silicosis.

48 The judgement as to the likelihood of the disease occurring under the particular conditions of work should be informed by the COSHH assessment. Factors to consider will include the likely extent and duration of exposure; evidence of disease in the industry; and importantly the robustness and reliability of the control measures, including maintenance, monitoring and assurance arrangements. HSE has published relevant guidance G404 Health surveillance for those exposed to RCS[17] and more detailed supplementary guidance to G404[18] for occupational health professionals on an example of a health surveillance programme for silicosis. This supplementary guidance advises health surveillance is required where workers are '*regularly exposed'* to RCS and where there is a '*reasonable likelihood'* that silicosis may occur.

49 ORR considers a precautionary approach to the provision of RCS health surveillance to be currently justified in the rail industry based on: the highly variable nature of RCS exposures particularly in mechanised track renewals, which are heavily influenced by the weather and variable ballast quality; a long RCS exposure history for many rail workers; the current heavy reliance on RPE as a primary control (RPE is particularly prone to failure if not fitted and maintained correctly, including failure to be clean shaven); and the lack of sufficient reliable RCS exposure monitoring data for all potentially higher risk tasks, particularly in conventional track renewals.

50 Rail employers may want to consult with occupational health professionals on the need and extent of any RCS health surveillance on a case-by-case basis. However, where an employer decides not to provide a health surveillance programme for RCS exposed employees, they should be able to justify and demonstrate to ORR that there is not a reasonable likelihood of those employees developing respiratory disease. Inspectors may want to seek specialist medical advice (via the RSD specialist team) in assessing the adequacy of a duty holder's RCS health surveillance programme.

51 Network Rail standard NR/L2/OHS/157 'Health surveillance for silica and asbestos and the management of diagnosed occupational respiratory conditions' requires at risk employees referred for RCS health surveillance to undergo lung function testing and complete a respiratory questionnaire annually. Those with over 15 years occupational exposure to silica are additionally referred for chest x-rays, repeated every 3 years. Abnormal lung function test results could also

[17] https://www.hse.gov.uk/pubns/guidance/g404.pdf

[18] https://www.hse.gov.uk/pubns/books/healthsurveillance.htm

trigger further investigation, which might also include chest x-ray. The 15-year exposure 'trigger' for provision of chest x-rays repeated every 3 years thereafter, aligns with the HSE supplementary guidance to G404. Advice regarding the management of employees identified as having RCS related disease is outlined in the HSE supplementary guidance to G404.

52 In 2020 Network Rail introduced a new model for delivery of statutory health surveillance by its occupational health provider, including initial telephone assessment to identify any need for onward referral. An update to the 2017 Network Rail standard NR/L2/OHS/157 to reflect these changes is expected.

Training and supervision: COSHH Regulation 12

53 We expect rail employers to provide sufficient training and supervision to ensure that RCS exposed workers understand the risks to their health; the purpose and results of RCS exposure monitoring and health surveillance; what control measures and procedures are needed for specific tasks or activities; how to properly use and maintain the control measures provided; and how to report concerns.

54 Basic awareness of risks from RCS is included in the Sentinel Industry Common Induction[19]competence. From January 2020 Network Rail withdrew the mandatory requirement for ICI competence for those working on Capital Delivery sponsored sites, replacing it with PTS competence (which is to be updated to capture many ICI elements). ICI competence on Sentinel will be retained for those working on LUL and Dockland Light Railway sites.

55 Extensive resources are available on Network Rail Safety Central to support mainline workers and managers to understand the risks[20] and recognise and manage respiratory hazards[21] including from RCS. A respiratory e-learning package[22] for both RPE users and its in-house face fit testers, has been developed. Dedicated BDWG resources include employee briefings, posters and newsletters; risk matrices to inform ballast handling COSHH assessments; and a reporting form to escalate concerns over 'dusty' ballast.

Enforcement considerations

56 When considering the extent to which the requirements for control of RCS as a carcinogen have been met, inspectors should continue to

[19] https://safetycentral.wpengine.com/tools-resources/industry-common-induction-ici/
[20] https://safety.networkrail.co.uk/wp-content/uploads/2015/07/Respiratory-Risks-video.mp4
[21] https://safety.networkrail.co.uk/healthandwellbeing/employee-information/respiratory-hazards/
[22] https://safety.networkrail.co.uk/healthandwellbeing/employee-information/respiratory-hazards/respiratory-e-learning-for-network-rail-employees/

adopt a proportionate approach to enforcement which recognises the practical challenges in implementing all of the requirements under COSHH Regulation 7(5) in every case, particularly the storage, handling and disposal of carcinogens in closed labelled containers, and regular cleaning of walls, floors and surfaces. Where specific requirements of Regulation 7(5) can be met in whole or in part, there is an expectation that they are implemented to the extent that they can be, in order to reduce the risks to as low as is reasonably practicable. There is unlikely to be a justification for not implementing those measures where a risk assessment determines that such a control measure is not unreasonable.

57 Inspectors should seek evidence and assurance that proper consideration has been given to the specific requirements for carcinogens under COSHH, and that the most effective protection measures appropriate to the activity and consistent with the risk assessment have been implemented. Based on current industry techniques and equipment used in mechanised track renewals and associated upstream ballast handling tasks, ORR does not consider the requirement for regular cleaning of walls, floors (track bed) and surfaces, and storage and handling of all ballast in closed labelled containers for these tasks to be proportionate or the most effective means of achieving adequate control.

58 ORR enforcement action should target those risk control measures that will have the biggest impact on minimising worker RCS exposures, specifically design improvements including effective engineering dust controls (integral and/or stand-alone), segregation, methods of work, training, suitable RPE, good hygiene, and housekeeping. Reasonably practicable benchmark standards for all these elements of the control hierarchy are set out in this guidance.

59 Prevention and improved plant design should be given proper consideration in the first instance, and should form part of a longer-term plan. In the short term, improvements to both operational and engineering controls, with RPE an interim additional measure, should provide a reasonably practicable means of ensuring adequate control and compliance. Where task-related non-compliance has been identified, underlying management failings should also be identified and addressed.

60 In addition to ORR's general guidance on use of the enforcement management model[23] (EMM), inspectors should also consider the HSE guidance on its application to health risks[24]and to specific hazardous

[23] https://www.orr.gov.uk/monitoring-regulation/rail/promoting-health-safety/investigation-enforcement-powers/enforcement-powers
[24] https://www.hse.gov.uk/foi/internalops/ocs/100-199/130_5/

substances[25]. HSE operational guidance on inspection and enforcement for construction dust[26]includes relevant enforcement considerations for RCS and the application of the EMM for common RCS construction tasks.

61 Regular exposure to RCS without the appropriate controls can result in serious irreversible disease, so the consequence under the EMM is *serious health effect***,** which is comparable with risk of serious personal injury. The benchmark standard set is *nil or negligible risk* of a serious ill health effect which means exposure reduced to a level proportionate to the health risk. This will only be achieved when all the required technical and procedural control measures are in place and working effectively, including control of RCS dust at source and suitable and adequate RPE where needed for higher risk tasks.

62 The likelihood of serious ill health occurring from RCS exposure will vary depending on the extent and duration of the exposure, as well as how reliable the risk controls are. The risk will generally be greater for those regularly exposed for prolonged periods, although some short duration tasks that can result in very high peak exposures also present a risk, and should be adequately controlled. Reliance on RPE as a primary control can also increase the likelihood of harm, as it is inherently less reliable than engineering controls.

63 HSE enforcement guidance for the stone working/concrete products sectors[27] and for construction dust can inform ORR enforcement decisions for comparable tasks (for example use of hand-held power tools on concrete, brick or stone), and for closing gaps in existing RCS controls. In determining the risk gap, the single casualty table of the EMM should be used, but inspectors will still need to take into account numbers exposed to the risk as part of a proportionate enforcement response. While many of the standards for RCS control are *established* (e.g. HSE guidance on expected RCS controls for construction and manufacturing, forced ventilation in machine cabs, and RCS health surveillance), rail industry guidance from RSSB, Network Rail, LUL and BDWG on dust control for ballast handling are *interpretative.*

64 Inspectors should give initial priority to minimising on-site risk (i.e. the controls and management systems) over monitoring the symptoms (i.e. health surveillance), and focus on those tasks where inadequate control can result in an *extreme or substantial* risk gap under the EMM. Where workers are subject to potentially significant and ongoing RCS exposure, or there is evidence of ill health related to RCS exposure, inspectors should make relevant enquiries and take action as necessary. Health surveillance is important as part of the protective measures required but it cannot be relied upon as the primary means of

[25] https://www.hse.gov.uk/foi/internalops/ocs/200-299/273_19.htm
[26] https://www.hse.gov.uk/foi/internalops/og/og-00017.pdf
[27] https://www.hse.gov.uk/foi/internalops/og/og-00109.pdf

protecting the worker. Adequate control of exposure is essential to prevent worker ill health.

65 Some construction type tasks such as cutting concrete kerbs/flags with a cut off saw, grinding mortar, surface grinding/scabbling with high energy hand tools, abrasive blasting of high silica materials, and pneumatic breaking of concrete in an enclosed space can produce very high RCS exposures if no effective controls are applied (giving a *probable* likelihood of a serious ill health effect) and the risk gap is likely to be *extreme*. Mechanised ballast handling in tunnels or other areas of restricted natural ventilation could also result in high exposures if no effective controls are applied (*probable* likelihood), again giving an *extreme* risk gap. Inspectors should deal with these as a priority with consideration to use of Prohibition Notices where there is inadequate control at source and no suitable and adequate RPE. Once any immediate risk has been addressed the objective of any further action should be to ensure that a dutyholder can achieve sustained compliance (e.g. by use of Improvement Notices).

66 It is less straightforward to provide an enforcement steer for mainline mechanised track renewals on open track, which is highly variable in nature and duration, and heavily influenced by weather conditions and ballast quality. Available exposure monitoring data show the potential for exposures significantly above the WEL for some higher risk tasks on high output and conventional track renewals sites particularly in dry conditions, suggesting a *probable* likelihood of serious health effect, but the bulk of the available RCS exposure monitoring data point towards a *possible* or *remote* likelihood. It is particularly difficult to make a numerical distinction between a possible and a remote likelihood given the known variability in RCS exposures even for the same task. A robust and precautionary approach for RCS as a recognised carcinogen would suggest a *possible* likelihood and *substantial* risk gap for mechanised track renewals. On-going improvements in engineering control across renewals operations should progressively reduce the likelihood of harm under EMM to those working alongside, but this has yet to be fully demonstrated by exposure monitoring results.

67 In many cases, the Initial Enforcement Expectation (IEE) for ballast handling tasks carried on outdoors is most likely to be an Improvement Notice. Strategic and duty holder factors should be applied to inform enforcement decisions as normal. Inspectors should take account of previous ORR advice given to duty holders on RCS control: for Network Rail High Output, Capital Delivery and many of its principal contractors, this will be substantial. Where there are ineffective technical or operational controls for RCS dust, inspectors should look to secure the urgent provision of suitable RPE for those working near sources of RCS dust, as an absolute minimum, and give consideration to enforcement of further improved controls using technical and organisational means.

68 For lower risk ballast handling tasks, where there is good evidence

	that exposures are consistently controlled to significantly below the WEL but more can still reasonably be done to further improve control, the IEE might be written advice. 69 Consideration may be given to prosecution where there is evidence of repeated or sustained non-compliance and poor practice, for example failure to rectify previous serious failings in RCS risk control, or evidence that high risk tasks have been undertaken over a significant period with wholly ineffective controls.
Action (optional)	**Action required**: ORR Inspectors/Inspector Assistants to note and follow the advice above on securing legal compliance in respect of worker exposure to RCS