



Review of the Main Guidance Documents on Occupational Safety and Health in the Remediation of Contaminated Sites

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INAIL's Department of Production Plants and Human Settlements is concerned with the health and safety-related aspects of remediation activities at contaminated sites. One of the main aspects of such activity is the identification of risks to human health and safety and the consequent selection of measures and actions needed to safeguard the persons involved in remediation work. These activities even though similar to those of the civil engineering and building sector, can differ greatly from them, and also from other occupational situations involving hazardous substances, bringing about specific, sometimes exclusive and specially varied hazards, e.g. the uncontrolled condition of the site and the large variety and number of substances that may be present and frequently unknown, particularly in the initial stages of an investigation. For this reason, publications illustrating the occupational health and safety risks referring generally to traditional "temporary or mobile construction sites" or to generic chemical hazards are inadequate.

The aim of this paper is to critically compare currently available specialized publications on worker protection to provide a complete and exhaustive overview of them, offering so a useful tool for occupational Safety and Health Management in contaminated sites. Considered publications were divided into "Publications of a general nature" (solely international), which, for their completeness and depth may be deemed as specialist manuals, and "Specific publications" (mainly national) that deal in depth with only specific aspects.

1. Publications of a general nature

The main publication of a general nature, in terms of depth and breadth of the dealt subjects, is "Occupational Safety and Health Guidance - Manual for Hazardous Waste Site Activities", National Institute for Occupational Safety and Health et al. (1985) (Table 1 - i). The text focuses on the evaluation, prevention and protection against potential risks in remediation sites. The first section of the document lists health and safety-related hazards (chemical exposure, explosions and fires, oxygen deficiency, ionizing radiation, biological hazards, safety hazards, electrical hazards, heat stress, cold exposure and noise) and for each one analyses the prevention and protection measures based on site characteristics and the work to be done. The guidance describes site planning, organizational aspects, and evaluates the following aspects: development of a general organisational structure, process and periodical re-examination and updating of a comprehensive work plan, development of a site safety plan consistent with the existing local contingency plan and enforced by safety meetings and inspection. Recommended training by job categories and medical programs are also discussed. The

second section of the guidance provides practical advice for operations, on methods to gather informations, identify site hazards and select worker protection measures. This section describes in detail a number of operating procedures (e.g. procedures for site characterisation, air monitoring, Personal Protective Equipment (PPE) selection and use, site control, emergency response, management of tanks and drums, etc.). Although it was published in 1985, the manual is still effective and topical in many parts. Its main characteristic is the breadth of discussed subjects and the completeness. One of the limits of the guidance is that it assumes a basic knowledge of science and experience in occupational safety and health. Furthermore many topics are tailored to the US territory thus not necessarily transferable to other environments. It is nevertheless cited in other national guidances (e.g. Western Australia Security Committee, 2005), being so an authoritative reference.

The second document is the International Standard ISO 10381 "Soil quality – Sampling" Part 3 "Guidance on Safety" (2001) (Table 1 - d), which provides information on the actual hazards workers may encounter during a site investigation and particularly, during soil sampling, on agricultural areas, on contaminated areas and in geological surveys. The guidance is a useful tool for identifying hazards, selecting management procedures, suggesting precautions in terms of personal protection and cleaning facilities and drawing up working procedures aimed at minimizing the hazards by contact, through ingestion, inhalation of contaminants and physical hazards associated with the collection of samples and the use of machinery. This standard, although international, is rarely cited in other guidance documents.

Another manual dealing with almost all occupational safety and health-related aspects is the "Guidance note: occupational safety and health management and contaminated sites work" (Western Australia Security Committee, 2005) (letter I in Table 1). It addresses employers, site owners, consultants, self employed people, employees, people in control of workplaces and safety and health representatives. The first section is dedicated to the assessments and management policy based on local regulations and clearly illustrates some of the fundamentals of the risk management process. Then it discusses: training and information, supervision of workers, storage and handling of hazardous substances, first aid procedures, PPE, monitoring and medical surveillance program. The second section summarizes informations about the specific security plan of site, preliminary and detailed investigations, purposes and methods of remediation, waste management. The Appendix contains a detailed checklist to identify, manage and control risks for each work phase. The document is easy to apply and very clear, but provides only general indications and is only locally recognised.

Another interesting Australian document is the "Guideline on Protection of Health and the Environment During the Assessment of Site Contamination" (National Environment Protection Council, 1999) (Table 1 - h). The Guideline frames the issues to be considered when preparing a site safety plan to properly address the safety and the risk of adverse health effects to the site workers, residents and nearby populations and the environment. It summarizes the phases of the investigation and the affected target. It also indicates the contents of a site safety plan based on the site-specific hazards, risks and level of PPE required. Finally environmental risks and the practices for waste disposal, accident/incident investigation, reporting and health surveillance are analyzed. Due to its conciseness, the document does not deepen all the actual hazards that may affect workers, and highlights environmental rather than occupational health and safety issues. The document is recognised only nationally.

In New Zealand the "Health and safety guidelines on the cleanup of contaminated sites" (Occupational Safety & Health) were published in 1994 (Table 1 - j). The document centres chiefly on industrial hygiene and occupational medicine-related aspects in site remediation. The document addresses employers, contractors, local authorities and other actors involved in the remediation process, which should use it to control exposure to hazardous substances in contaminated sites. The guidance provides basic information on the identification, evaluation and management of the hazards associated with site cleanup particularly the exposure to chemicals and useful information about work planning and organisation. Then it provides guidelines to prepare the health and safety plan and a synthesis of safe work methods and conditions, describes generally air monitoring, health surveillance, information training and supervision requirements, PPE as well as control measures to be undertaken. The guide treats the most of the arguments schematically and does not provide complete occupational health advice on any particular situation, but rather it gives general advice to be used to develop the appropriate safety procedures. This document too is essentially applicable at a national level.

The final general examined document is “Unified facilities guide specifications - Health, safety, and emergency response procedures for contaminated sites” (United States Department of Defense, 2009) (Table 1 - k). It covers requirements for safety and health documents and procedures for hazardous waste site cleanup projects. Its first part gives some general directions for site safety and health planning, for site description and contamination characterization, specific hazards identification, training, staff organization, qualification and responsibilities. The following part describes PPE, the medical surveillance, exposure monitoring and air sampling programs and outline some other specific aspects (e.g. spill and discharge control, handling of drums and containers, confined spaces entry procedures, ignition sources, fire prevention and protection, electrical safety, excavation and trench safety, detailed procedures for tank dismantling, etc.). Since the guidance is specific for US military setting, a number of sections are reserved or refers to confidential documents.

2. Specific publications

Among the “specific publications”, deepening only some specific aspects, the “Guideline on Risk Assessment at Work”, (European Commission, 1996), based on Council directive 89/391/EEC is the first evaluated addressed to the member state (Table 1 - b). But it will also help employers and the mentioned company stakeholders the framework Directive 89/391/EEC.. It addresses to the Member States to be adapted for help and advice for employers, managers, officers, workers, and/or their representatives, safety experts and others who deal with the instrument of workplace risk assessment in practice, also to fulfil their duties as laid down in the “Council’s framework” directive 89/391/EEC. It describes how the strategies to identify the hazards and control the risks should be based on the consultation and participation of all the involved parties. The first of its two main sections illustrates risk assessment and management criteria and suggests how external services can be used to define occupational risks, and how relative effectiveness and reliability can be controlled. The other section focuses on the needs of small and medium enterprises. The guideline provides a schematic but very effective view of the risk evaluation procedure. Although risk evaluation is the main theme of the document, some aspects of the risk management are also considered, but only to a limited extent. The guide is recognized by all EU Member States and its general provisions are still up-to-date and in line with current good practice.

Another interesting sectorial publication is the manual on “La sicurezza per gli operatori degli impianti di trattamento e di stoccaggio dei rifiuti solidi urbani” (The safety of workers of municipal solid waste treatment and storage facilities) (Istituto Nazionale Assicurazione Infortuni sul Lavoro, 2009). The publication provides the result of a study realized with some local authorities and enterprises operating in the sector (Table 1 - c). It is based on several inspections carried out over many years in municipal solid waste treatment, handling and storage facilities and takes into account the monitoring data of some common hazards. The aim is to improve worker safety policies, by 1) illustrating suitable worker prevention and protection measures (collective, individual, management, organisational and technological); 2) identifying biological and chemical hazards in the light of the carried monitoring campaigns; 3) recommending actions to improve working conditions and workplaces for workers in charge of plant operation and maintenance who might be the first suffering harmful health effects. The document provides an immediate overview of hazards and methods for identifying, evaluating and managing all present risks (chemical, physical, biological, mechanical, fire and explosion) by some annexed fact sheets. A summary providing analytical methods and for biological, chemical and physical agent monitoring is also enclosed. This document is of local relevance.

Another specialistic study titled “Profili di rischio nelle attività di indagine, bonifica, messa in sicurezza delle aree industriali dismesse” on Risk profiles in investigation, remediation and safety containment activities in abandoned industrial areas, (ISPESL, now INAIL, et al., 2001) has been made with the collaboration of the local Health Authority of Milan (Table 1 - g). This study gives the findings of the analysis conducted during surveillance activity at contaminated sites and abandoned industrial areas in Milan. In most cases these areas were environmentally damaged and had to be cleaned up on the basis of preliminary environmental investigation and subsequent remediation work. The document has the dual aim of experience sharing and standard proposing. The data for the city of Milan are significant, showing, for a heavily industrialised area, the extent of the actual risks and the importance

of investigation methods and intervention criteria. The study also showed that, in terms of occupational health and safety, environmental surveying and remediation activity has often analogies with the building sector, but also features requiring specific measures. The publication is divided into sections based on work phases (preliminary evaluation, safety containment, preliminary investigation, characterisation plan, preliminary design, detailed investigation, final design), and illustrates works performed, equipment and machinery used, plants and installations, risk factors, expected damage, planned actions, reference legislation and external risk factors.

The same Institute (ISPESL, now INAIL) also presented in 2008 the "Operating Guidance to specific risks in entering silos, septic tanks, sewers, wastewater plants and tanks for dangerous substances" (Table 1 - f) in collaboration with complementary authorities (Fire dept., local Health Authorities, Universities, etc). The document followed a series of serious accidents occurred in confined spaces, the frequency of which is related to the occasional nature of such works and the small size of the involved enterprises (more vulnerable in terms of safety due to their poor resources and skills), characterizing the majority of Italian industry. The identification of hazardous substances and the associated risks are treated in detail. The related annexes are about TLVs, criteria for classification and labelling of hazardous chemicals, some quick reference cards for the most common of them and potentially hazardous areas and activities. General procedures for assessing and managing risks in confined spaces are also described. Final information on instruments and analytical methods to detect hazardous substances and on the PPE is provided. The document is of national relevance.

The "Guida ISPESL per l'esecuzione in sicurezza delle attività di scavo", (ISPESL Guidance to excavation safety, 2001) describes the most frequent excavation hazards (foundation works, construction of underground utilities – water, gas, telecommunications, power - road and railway construction, etc.), potential resulting damage, proper planning, work phases and safety measures (Table 1 - e). The excavation technologies, also outdoor and alternative ones, and related safety systems, particularly provisional support ones are detailed. Finally an extensive technical and procedural section for reducing risk in digging activities and for maintenance and inspection is provided. The guidance is recognised as a national technical reference document.

Another specific technical guidance is the document "ICG 44/09/E" (European Industrial Gases Association, 2009) referring to oxygen depleted workplaces (Table 1 - a). This document of local significance provides a thorough description of the risk of asphyxiation, related hazards and relative protection and prevention measures. Though not specific for remediation activities, this last two guidance documents thoroughly analyses two of their highly risky phases.

3. Final comparison

All documents have been analytically compared to evaluate studied subjects, risks and identified prevention and mitigation measures. A comparison table is reported below (Table 1), listing on the X-axis the examined publications and on the Y-axis the considered specific risks, grouped into four macro-areas: safety risks, health risks, transversal risks, other risks.

Table 1: Comparison grid showing the major publications vs. all the specific risks potentially present (a=EIGA; b= European Commission; c= INAIL; d= ISO; e= ISPESL 2008a; f= ISPESL 2008b; g= ISPESL 2001; h= NEPC; i=NIOSH; j=OSH; k= US Department of Defense; l=WASC)

Specific risks: categories and risks		Publications										
		a	b	c	d	e	f	g	h	i	j	k
Safety	Safety risks relating to working areas (in general)	X	X	X	X		X	X	X	X		X
	Stability of the workplace			X	X	X			X	X		
	Risks associated with the presence of hazardous chemicals	X	X	X			X	X	X	X		
	Flammable			X	X		X	X	X	X		
	Corrosive								X	X		
	Reactive						X	X		X		
	Explosive	X		X	X	X	X	X	X	X		
	Reactive unstable	X			X						X	
	Oxygen depletion	X			X	X	X					

Specific risks: categories and risks		Publications											
		a	b	c	d	e	f	g	h	i	j	k	l
Specific risks: categories and risks		Publications											
		a	b	c	d	e	f	g	h	i	j	k	l
Health	<i>Risks from exposure to chemical (in general)</i>		X	X	X		X	X	X	X	X		X
	Irritants						X	X		X			
	Harmful			X	X		X	X					
	Toxic			X	X		X	X					
	Carcinogenic			X	X		X		X				
	Corrosive							X					
	Infectious				X		X						
	Teratogenic				X		X						
	Mutagenic						X						
	In contact with water, air or an acid, give off a very/toxic gas	X						X					
	Susceptible, after disposal, to give rise to another substance				X								
	Sensitizing				X								
	<i>Risks from exposure to biological agents (in general)</i>			X	X		X		X	X			
	Virus			X	X		X						
	Bacteria			X	X								
	Fungi			X									
	Parasites			X									
	Cell culture						X						
	MOGM						X						
	Pests (arthropods)			X	X				X				
	Vehicles of infection (rats, mosquitoes, etc.)			X	X				X				
	<i>Risks from exposure to physical agents (in general)</i>	X				X							
	Ionizing and non ionizing radiations				X		X	X					X
Transverse	<i>Interaction with the external (in general)</i>	X						X	X				
	Risks from outside				X								
	Risks to outside							X	X				
Other	Risks from dust			X		X		X					
	Risks machines			X	X	X		X	X				
	Risks microclimate (heat)	X		X	X	X	X	X	X	X		X	

4. Conclusions

This paper is to be intended as a tool in the Health and Safety Management of remediation activities at contaminated sites. It provides an overview of the main general and specialist publications, considering also that at a local level there are numerous other interesting documents on some specific risks of remediation work. The comparison appears to downgrade the usefulness of those publications that devote more attention to the management and planning of activities (e.g. j, l) than to single risks (e.g. f, g).

The comparison in Table 1 shows that the most frequent risks taken into account are:

- safety risks relating to working areas in general;
- risks from exposure to chemical (in general);
- risks related to microclimate (heat)

although for those in general there are some topics more in depth and others less.

The comparison shows that very poor attention seems to be paid to the following risks which in the future should be studied in more depth:

- health risk from exposure to corrosive, mutagenic, sensitizing substances and form susceptible, after disposal, to give rise to another substance ones;
- biological hazards related to fungi, parasites, cell culture and MOGM;
- risks from/to outside.

Furthermore, it should be marked that risks from exposure to physical agents are treated only in general with the exception of ionizing and not ionizing radiations representing the only specific physical

risks in remediation activities. The comparison also highlights the lack of a single document showing all the specific risks to which workers, involved in remediation, are exposed.

References

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