Environmental, Health, and Safety Guidelines for Telecommunications

Introduction

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP)[1]. When one or more members of the World Bank Group are involved in a project, these EHS Guidelines are applied as required by their respective policies and standards. These industry sector EHS guidelines are designed to be used together with the **General EHS Guidelines** document, which provides guidance to users on common EHS issues potentially applicable to all industry sectors. For complex projects, use of multiple industry-sector guidelines may be necessary. A complete list of industry-sector guidelines can be found at: www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines

The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving them.

The applicability of the EHS Guidelines should be tailored to the hazards and risks established for each project on the basis of the results of an environmental assessment in which site-specific variables, such as host country context, assimilative capacity of the environment, and other project factors, are taken into account. The applicability of specific technical recommendations should be based on the professional opinion of qualified and experienced persons.

When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in these EHS Guidelines are appropriate, in view of specific project circumstances, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment.

Applicability

The EHS Guidelines for Telecommunications are applicable to telecommunications infrastructure such as fixed line and wireless voice and data transmission infrastructure, including long distance terrestrial and submarine cables (e.g. fiber optic cables), as well as radio and television broadcasting, and associated telecommunications and broadcasting installations and equipment.[2] This document is organized according to the following sections:

Section 1.0 — Industry-Specific Impacts and Management
Section 2.0 — Performance Indicators and Monitoring
Section 3.0 — References
Annex A — General Description of Industry Activities

[1] Defined as the exercise of professional skill, diligence, prudence and foresight that would be reasonably expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances globally. The circumstances that skilled and experienced professionals may find when evaluating the range of pollution prevention and control techniques available to a project may include, but are not limited to, varying levels of environmental degradation and environmental assimilative capacity as well as varying levels of financial and technical feasibility.

[2] Associated installations and equipment include cellular, micro wave, and other radio-based systems; satellite receivers; wire line and wireless receiving, transmitting, and switching stations, and related equipment such as masts and towers, cables and connectors, equipment housing such as shelters and cabinets, backup batteries, and auxiliary power units (generators).

1.0 Industry-Specific Impacts and Management

The following section provides a summary of EHS issues associated with telecommunications projects and infrastructure which occur during the construction and operational phase, along with recommendations for their management. General guidance applicable to construction and decommissioning activities is provided in the **General EHS Guidelines**.

1.1 Environment

Environmental issues in telecommunications projects primarily include the following:

- Terrestrial habitat alteration
- Aquatic habitat alteration
- Visual impacts
- Hazardous materials and waste
- Electric and magnetic fields
- Emissions to air
- Noise

Terrestrial Habitat Alteration

Terrestrial and aquatic habitats may be altered primarily during the construction of communications infrastructure depending on the type of infrastructure component and proposed location. Potential impacts to habitat may be more significant during construction and installation of linear infrastructure, such as long distance fixed line cables, as well as access roads to other types of infrastructure along previously undeveloped land.

Recommended measures to prevent and control impacts to terrestrial habitats during construction of the right-of-way include:

- Site fixed line infrastructure (e.g. fiber optic cable) and other types of linear infrastructure rights-of-way, access roads, lines, and towers to avoid critical habitat through use of existing utility and transport corridors, whenever possible;
- Avoidance of construction activities during the breeding season and other sensitive seasons or times of day;
- Revegetation of disturbed areas with native plant species;
- Management of construction site activities as described in relevant sections of the **General EHS Guidelines**.

Avian Collisions

The height of some television and radio transmission towers can pose a potentially fatal risk to birds mainly through collisions.[3] The likelihood of avian collisions is thought to increase with the height and design of the communications tower (e.g. guyed towers represent a higher potential for collisions), the presence of tower lighting (which attracts some species of birds at night or during low light conditions), and, most importantly, the tower location with regard to flyways or migration corridors.[4]

Recommended prevention and control measures to minimize avian collisions include[5]:

- Siting towers to avoid critical habitats (e.g. nesting grounds, heronries, rookeries, foraging corridors, and migration corridors);
- Avoiding the cumulative impact of towers by collocating antennae on existing towers or other fixed structures (especially cellular telephone communication antennae), designing new towers structurally and electrically to accommodate future users, and removing towers no longer in use;

[3] Manville (2205) Bird Strikes and Electrocutions at Power Lines, Communication Towers, and Wind Turbines: State of the Art and State of the Science – Next Steps Toward Mitigation.

[4] Ibid.

[5] Further information is available from the United States (US) Department of Interior, Fish and Wildlife Service, Service Guidance on the Siting, Construction, Operation and Decommissioning of Communications Towers (2000).

- To the extent feasible, limiting the tower height and giving preference to non-guyed tower construction designs (e.g. using lattice structures or monopoles);
- If guy wired towers are located near critical bird habitats or migratory routes, installing visibility enhancement objects (e.g. marker balls, bird deterrents, or diverters) on the guy wires;
- Limiting the placement and intensity of tower lighting systems to those required to address aviation safety. Possible alternatives include the use white and / or strobe lighting systems.

Aquatic Habitat Alteration

Depending on their location, the installation of fixed line components, including shore approaches for long distance fiber optic cables, and access roads to transmission towers and other fixed infrastructure, may require construction of corridors crossing aquatic habitats with the potential to disrupt watercourses, wetlands, coral reefs, and riparian vegetation.

Recommended measures to prevent and control impacts to aquatic habitats include:

- Site power transmission towers and substations to avoid critical aquatic habitat such as watercourses, wetlands, and riparian areas, as well as fish spawning habitat, and critical fish over-wintering habitat, whenever possible;
- Maintaining fish access when road crossings of watercourses are unavoidable by utilizing clearspan bridges, open-bottom culverts, or other approved methods;
- Minimizing clearing and disruption to riparian vegetation;
- Management of construction site activities as described in the relevant sections of the **General EHS Guidelines**.

Marine Habitat Alteration

Long distance telecommunications cables (e.g. fiber optic cables) may reach across ocean stretches. Cables are typically installed using a cable-laying vessel and a remotely operated, underwater vehicle. Issues associated with marine habitat alteration include disruption to intertidal vegetation and marine life, including marine mammals, and sedimentation resulting in turbidity and reductions in water quality.

Recommended measures to prevent and control impacts to marine habitats include:

- Locating and siting cable routes, and shore access, to avoid critical marine habitats, such as coral reefs and breeding grounds;
- Burying submarine cables when traversing sensitive intertidal habitat;
- Monitoring cable laying path for presence of marine mammals;
- Avoiding laying of submarine cable during fish and marine mammals breeding periods, calving periods, and spawning seasons.

Visual Impacts

The visual impacts from tower and antennae equipment may depend on the perception of the local community as well as the aesthetic value assigned to the scenery (e.g. scenic and tourism areas). Recommendations to prevent, minimize and control the visual impacts include:

- Minimizing construction of additional towers through co-location of proposed antennae in existing towers or existing structures such as buildings or power transmission towers;
- Use of tower and antennae camouflaging or disguising alternatives (e.g. masts or towers designed to look as trees);
- Taking into account public perception about aesthetic issues by consulting with the local community during the siting process of antenna towers.

Hazardous Materials and Waste

Telecommunications processes do not normally require the use of significant amounts of hazardous materials. However, the operation of certain types of switching and transmitting equipment may require the use backup power systems consisting of a combination of batteries (typically lead-acid batteries) and diesel-fueled backup generators for electricity. Operations and maintenance activities may also result in the generation of electronic wastes (e.g. nickel-cadmium batteries and printed circuit boards from computer and other electronic equipment as well as backup power batteries). The operation of backup generators and service vehicles may also result in the generation of used tires, and waste oils and used filters. Transformer equipment may potentially contain Polychlorinated Biphenyls (PCBs) while cooling equipment may contain refrigerants (potential Ozone Depleting Substances [ODSs]).

Recommended hazardous materials management actions include:

- Implementing fuel delivery procedures and spill prevention and control plans applicable to the delivery and storage of fuel for backup electric power systems, preferably providing secondary containment and overfill prevention for fuel storage tanks;
- Implementing procedures for the management of lead acid batteries, including temporary storage, transport and final recycling by a licensed facility;
- Ensuring that new support equipment does not contain PCBs or ODSs. PCBs from old equipment should be managed as a hazardous waste;[6]
- Purchasing electronic equipment that meets international phase out requirements for hazardous materials contents and implementing procedures for the management of waste from existing equipment according to the hazardous waste guidance in the **General EHS Guidelines**.[7] Considering the implementation of a take-back program for consumer equipment such as cellular telephones and their batteries.

Electric and Magnetic Fields

Electric and magnetic fields (EMF) are invisible lines of force emitted by and surrounding any electrical device, such as power lines and electrical equipment. Electric fields are produced by voltage and increase in strength as the voltage increases. Magnetic fields result from the flow of electric current and increase in strength as the current increases. Radio waves and microwaves emitted by transmitting antennas are one form of electromagnetic energy. Radio wave strength is generally much greater from radio and television broadcast stations than from cellular phone communication base transceiver stations. Microwave and satellite system antennas transmit and receive highly concentrated directional beams at even higher power levels.

Although there is public and scientific concern over the potential health effects associated with exposure to EMF (not only high-voltage power lines and substations or radio frequency transmissions systems, but also from everyday household uses of electricity), there is no empirical data demonstrating adverse health effects from exposure to typical EMF levels from power transmissions lines and equipment.[8]

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[6] Additional requirements may include host-country commitments under the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their disposal (http://www.basel.int/) and Rotterdam Convention on the prior Inform Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (http://www.pic.int/).

[7] For example, the use of lead, mercury, cadmium, chromium (Cr VI), polybrominated biphenyls, and polybrominated diphenyl ethers should be restricted or phased out as described in European Union Directives (2003a and 2003b).

[8] International Commission on Non-Ionizing Radiation Protection(ICNIRP) (2001); International Agency for Research on Cancer (2002); US National Institute of Health (2002); Advisory Group to the United Kingdom National Radiation Protection Board (2001), and US National Institute of Environmental Health Sciences (1999).

However, while the evidence of adverse health risks is weak, it is still sufficient to warrant limited concern.[9] Recommendations applicable to the management of EMF exposures include:

- Evaluating potential exposure to the public against the reference levels developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP).[10,11] Average and peak exposure levels should remain below the ICNIRP recommendation for General Public Exposure[12];
- Limiting public access to antennae tower locations (see also 'Community Health and Safety' of this document, below);
- Following good engineering practice in the siting and installation of directional links (e.g. microwave links), to avoid building structures;
- Taking into account public perception about EMF issues by consulting with the local community during the siting process of antenna towers.

Emissions to Air

Emissions from telecommunications projects may be primarily associated with the operation of vehicle fleets, the use of backup power generators, and the use of cooling and fire suppression systems. Recommended management actions to minimize emissions include:

- Implementation of vehicle fleet and power generator emissions management strategies as described in the **General EHS Guidelines** and avoiding the use of backup power generators as a permanent power source, if feasible;
- Substitution in use of chlorofluorocarbons (CFCs) in cooling and fire-suppression systems, using contractors who are properly trained or certified in the management of CFCs.

Noise

The principal source of noise in telecommunications facilities is associated with the operation of backup power generators. Recommended noise management action includes the use of noise suppression shields and mufflers, as well as the location of noise generating sources away from residential or other noise-sensitive receptors to meet the noise emission levels provided in the **General EHS Guidelines**.

1.2 Occupational Health and Safety

Occupational health and safety issues in telecommunications projects primarily include the following:

- Electrical safety
- Electromagnetic fields (occupational)
- Optical fiber safety
- Elevated and overhead work
- Fall protection
- Confined space entry
- Motor vehicle safety

Occupational health and safety hazards may also arise during construction and are common to other types of construction sites and are described in detail, along with measures for their prevention and control, in the **General EHS Guidelines**.

Excavation, construction, and repair of some components of a telecommunications system may result in workers' exposure to existing aboveground or underground utilities, including aerial or

[9] US National Institute of Environmental Health Sciences (2002)

[10] See ICNIRP Guidelines for Limiting Exposure to Time-varying Electric, Magnetic, and Electromagnetic Fields. The standards are based on evaluations of biological effects that have been established to have health consequences. ICNIRP is endorsed by the World Health Organization (WHO). WHO reviews drew the conclusion that exposures below the limits recommended by the ICNIRP international guidelines do not appear to have any known consequence on health.

[11] For additional source of information, see the Institute of Electrical and Electronics Engineers (IEEE) (2005).

[12] The ICNIRP exposure guidelines for General Public Exposure are listed in Section 2.1 of this Guideline.

buried electric transmission lines or buried natural gas and petroleum pipelines. Identification and location of all relevant existing underground utilities should be undertaken prior to any excavation and trenching activities.

Electrical Safety

Telecommunications workers may be exposed to occupational hazards from contact with live power lines during construction, maintenance, and operation activities. Prevention and control measures associated with live power lines include:

- Only allowing trained and certified workers to install, maintain, or repair electrical equipment;
- Deactivating and properly grounding live power distribution lines before work is performed on, or in close proximity to, the lines;
- Ensuring that live-wire work is conducted by trained workers with strict adherence to specific safety and insulation standards. Qualified or trained employees working on transmission or distribution systems should be able to achieve the following[13]:
    - Distinguish live parts from other parts of the electrical system
    - Determine the voltage of live parts
    - Understand the minimum approach distances outlined for specific live line voltages
    - Ensure proper use of special safety equipment and procedures when working near, or on, exposed energized parts of an electrical system
- Workers should not approach an exposed, energized or conductive part even if properly trained unless:
    - The worker is properly insulated from the energized part with gloves or other approved insulation; or
    - The energized part is properly insulated from the worker and any other conductive object; or
    - The worker is properly isolated and insulated from any other conductive object (live-line work)
- Where maintenance and operation is required within minimum setback distances, specific training, safety measures, personal safety devices, and other precautions should be defined in a health and safety plan[14];

Recommendations to prevent, minimize, and control injuries related to electric shock include:

- All electrical installations should be performed by certified personnel and supervised by an accredited person. Certification for such work should include theoretical as well as practical education and experience;
- Strict procedures for de-energizing and checking of electrical equipment should be in place before any maintenance work is conducted. If de-energizing is not possible, electrical installations should be moved or insulated to minimize the hazardous effects;
- Prior to excavation works, all existing underground cable installations should be identified and marked. Drawings and plans should indicate such installations;
- All electrical installations or steel structures, such as masts or towers, should be grounded to provide safety as the electrical current chooses the grounded path for electrical discharge. In cases where maintenance work has to be performed on energized equipment, a strict safety procedure should be in place and work should be performed under constant supervision;
- Personnel training should be provided in revival techniques for victims of electric shock.

[13] Further information is available from the Occupational Safety and Health Administration (OSHA), 29 CFR 1910.268 (Telecommunications).

[14] Additional information on setback distances applicable to telecommunications work is provided in OSHA, 29 CFR 1910.268.

Electromagnetic fields (EMF)

Electric and magnetic fields (EMF) are described in Section 1.1 above. Telecommunications workers typically have a higher exposure to EMF than the general public due to working in proximity to transmitting antennas emitting radio waves and microwaves. Radio wave strength is generally much greater from radio and television broadcast stations than from cellular phone communication base transceiver stations. Microwave and satellite system antennas transmit and receive highly concentrated directional beams at even higher power levels.[15]

Occupational EMF exposure should be prevented or minimized through the preparation and implementation of an EMF safety program including the following components:

- Identification of potential exposure levels in the workplace, including surveys of exposure levels in new projects and the use of personal monitors during working activities;
- Training of workers in the identification of occupational EMF levels and hazards;
- Establishment and identification of safety zones to differentiate between work areas with expected elevated EMF levels compared to those acceptable for public exposure, limiting access to properly trained workers;
- Implementation of action plans to address potential or confirmed exposure levels that exceed reference occupational exposure levels developed by international organizations such as the International Commission on Non-Ionizing Radiation Protection (ICNIRP), and the Institute of Electrical and Electronics Engineers (IEEE)[16]. Personal exposure monitoring equipment should be set to warn of exposure levels that are below occupational exposure reference levels (e.g. 50 percent). Action plans to address occupational exposure may include deactivation of transmission equipment during maintenance activities, limiting exposure time through work rotation, increasing the distance between the source and the worker, when feasible, use of shielding materials; or installation of ladders or other climbing devices inside the mast or towers, and behind the transmission beams.

Optical Fiber Safety

Workers involved in fiber optic cable installation or repair may be at risk of permanent eye damage due to exposure to laser light during cable connection and inspection activities.[17] Workers may also be exposed to minute or microscopic glass fiber shards that can penetrate human tissue through skin or eyes, or by ingestion or inhalation. Optical fiber installation activities may also pose a risk of fire due to the presence of flammable materials in high-powered laser installation areas. Recommendations to prevent, minimize, and control injuries related to fiber optic cables installation and maintenance include:

- Worker training on specific hazards associated with laser lights, including the various classes of low and high power laser lights, and fiber management;
- Preparation and implementation of laser light safety and fiber management procedures which include:
  - Switching off laser lights prior to work initiation, when feasible
  - Use of laser safety glasses during live optical fiber systems installation
  - Prohibition of intentionally looking into the laser of fiber end or pointing it at another person

[15] Although detailed studies of workplace exposure to EMF in the United States, Canada, France, England, and several Northern European countries have found no conclusive link or correlation between typical occupational EMF exposure and adverse health effects, some studies have identified a possible association between occupational exposure to EMF and cancer, such as brain cancer (U.S. National Institute of Environmental Health Sciences 2002) indicating there is evidence to warrant limited concern.

[16] The ICNIRP exposure guidelines for Occupational Exposure are listed in Section 2.2 of this Guideline.

[17] When extending a cable or mounting a cable connector, a microscope is typically attached to the end of the fiber optic cable allowing the worker to inspect the cable end and prepare the thin glass fibers for extension or connection assembly.

  - Restricting access to the work area, placing warning signs and labeling of areas with potential for exposure to laser radiation, and providing adequate background lighting to account for loss of visibility with the use of protective eyewear
  - Inspecting the work area for the presence of flammable materials prior to the installation of high-powered laser lights
- Implementation of a medical surveillance program with initial and periodic eye examinations;
- Avoiding exposure to fibers through use of protective clothing and separation of work and eating areas.

Elevated and Overhead Work

The assembly of towers and installation of antennae can pose a physical hazard to workers using lifts and elevated platforms and those located below due to the potential for falling objects. Recommended management strategies include:

- The area around which elevated work is taking place should be barricaded to prevent unauthorized access. Working under other personnel should be avoided;
- Hoisting and lifting equipment should be rated and maintained and operators trained in their use. Elevating platforms should be maintained and operated according to established safety procedures that include such aspects as equipment and use of fall protection measures (e.g. railings), movement of location only when the lift is in a retracted position, repair by qualified individuals, and the use of effective locks to avoid unauthorized use by untrained individuals;
- Ladders should be used according to pre-established safety procedures including proper placement, climbing, standing, and the use of extensions.

Fall Protection

Workers may be exposed to occupational hazards when working at elevation during construction, maintenance, and operation activities. Prevention and control measures for working at height include:

- Implementation of a fall protection program that includes training in climbing techniques and use of fall protection measures; inspection, maintenance, and replacement of fall protection equipment; and rescue of fall-arrested workers, among others;
- Establishment of criteria for use of 100 percent fall protection (typically when working over 2 meters (m) above the working surface, but sometimes extended to 7m, depending on the activity). The fall protection system should be appropriate for the tower structure and necessary movements, including ascent, descent, and moving from point to point;
- Installation of fixtures on tower components to facilitate the use of fall protection systems;
- Provision of an adequate work-positioning device system for workers. Connectors on positioning systems should be compatible with the tower components to which they are attached;
- Safety belts should be of not less than 16 millimeters (mm) (5/8 inch) two-in-one nylon or material of equivalent strength. Rope safety belts should be replaced before signs of aging or fraying of fibers become evident;
- When operating power tools at height, workers should use a second (backup) safety strap.

Confined spaces

The type of confined spaces encountered in telecommunications projects varies, but may include underground fixed line infrastructure co-located with other underground infrastructure in urban areas. Telecommunications facility operators should develop and implement confined space entry procedures as described the **General EHS Guidelines**.

Motor vehicle safety

The geographically dispersed nature of the infrastructure of some telecommunications operators may require the frequent use of ground transportation for maintenance activities. Under these circumstances, companies should prepare and implement motor vehicle safety programs to protect the safety of its workers and the communities in which they operate. Specific recommendations for motor vehicle safety are provided in the **General EHS Guidelines**.

1.3 Community Health and Safety

Examples of community health and safety issues identified during the construction phase include exposure to construction vehicles and transports, and exposure to dust, noise and vibrations caused by constructions works. These hazards are common to most typical construction sites and are described in detail, along with measures for their prevention and control, in the **General EHS Guidelines**.

Operational phase occupational hazards associated with telecommunications projects include:

- Structural and site access issues
- Aircraft navigation safety
- Driver safety and cellular phones

Structural and site access issues

Communities may be exposed to structural safety issues in the event of structural failure of masts or towers. These same sites may also attract unauthorized persons interested in climbing these structures, also representing a risk to their safety. Recommendations to manage site safety issues include:

- Design and installation of tower structures and components according to good international industry practice[18], taking into account the potential frequency and magnitude of natural hazards;
- Erection of fences in combination with other institutional controls and management approaches, such as the posting of signs forbidding entry and placement of guards to protect the premises surrounding the site;
- Equipping masts or towers with anti-climbing devices to preclude unauthorized climbing.

Aircraft navigation safety

Antenna towers, if located near an airport or known flight paths, can impact aircraft safety directly through collision or indirectly through radar interference. Aircraft collision impacts can be mitigated by:

- Avoiding the siting of towers close to airports and outside of known flight path envelopes;
- Consultation with regulatory air traffic authorities prior to installation, in accordance with air traffic safety regulations.

Driver Safety and Cellular Phones

Telecommunications companies who provide cellular phone service have little or no influence over the safe use of these devises by their clients. However, to the extent feasible, companies should promote the safe use of cellular telephones through such methods as customer information campaigns which may include distribution of information at the time of customer service sign-up or by mail with billing information, or through public advertising campaigns.

[18] For example, the Structural Standards for Steel Antenna Towers and Antenna Supporting Structures (ANSI/TIA 222-G-2005) of the Telecommunications Industry Association (http://www.tiaonline.org/index.cfm)

2.0 Performance Indicators and Monitoring

2.1 Environment

Emissions and Effluent Guidelines

Telecommunications activities do not typically give rise to significant air emissions or effluents. Instead, site operations should apply the principles and guidelines described above and in the **General EHS Guidelines,** especially with regards to emissions or effluents during construction operations or from administrative and maintenance facilities. Table 1 lists exposure limits for general public exposure to electric and magnetic fields published by the International Commission on Non-Ionizing Radiation Protection (ICNIRP).

Combustion source emissions guidelines associated with steam- and power-generation activities from sources with a capacity equal to or lower than 50 MWth are addressed in the **General EHS Guidelines** with larger power source emissions addressed in the **EHS Guidelines for Thermal Power**. Guidance on ambient considerations based on the total load of emissions is provided in the **General EHS Guidelines**.

Table 1. ICNIRP exposure guidelines for general *public* exposure to electric and magnetic fields.

Frequency	Electric Field (v/m)	Magnetic Field (µT)
3 – 150 kHz	87	6.25
10 – 400 MHz	28	0.092
2 – 300 GHz	61	0.20

Environmental Monitoring

Environmental monitoring programs for this sector should be implemented to address all activities that have been identified to have potentially significant impacts on the environment during normal operations and upset conditions. Environmental monitoring activities should be based on direct or indirect indicators of emissions, effluents, and resource use applicable to the particular project. Monitoring frequency should be sufficient to provide representative data for the parameter being monitored. Monitoring should be conducted by trained individuals following monitoring and record-keeping procedures and using properly calibrated and maintained equipment. Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken.

2.2 Occupational Health and Safety

Occupational Health and Safety Guidelines

Occupational health and safety performance should be evaluated against internationally published exposure guidelines, of which examples include the Threshold Limit Value (TLV®) occupational exposure guidelines and Biological Exposure Indices (BEIs®) published by American Conference of Governmental Industrial Hygienists (ACGIH),[19] the Pocket Guide to Chemical Hazards published by the United States National Institute for Occupational Health and Safety (NIOSH),[20] Permissible Exposure Limits (PELs) published by the Occupational Safety and Health Administration of the United States (OSHA),[21] Indicative Occupational Exposure Limit Values published by European Union member states,[22] or other similar sources.

Additional indicators specifically applicable to telecommunications activities include the ICNIRP exposure limits for occupational exposure to electric and magnetic fields listed in Table 2.

[19] Available at: http://www.acgih.org/TLV/ and http://www.acgih.org/store/
[20] Available at: http://www.cdc.gov/niosh/npg/
[21] Available at: http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9992
[22] Available at: http://europe.osha.eu.int/good_practice/risks/ds/oel/

Table 2. ICNIRP exposure guidelines for *occupational* exposure to electric and magnetic fields.		
Frequency	Electric Field (v/m)	Magnetic Field (µT)
0.82 – 65 kHz	610	30.7
10 – 400 MHz	61	0.2
2 – 300 GHz	137	0.45

Accident and Fatality Rates

Projects should try to reduce the number of accidents among project workers (whether directly employed or subcontracted) to a rate of zero, especially accidents that could result in lost work time, different levels of disability, or even fatalities. Facility rates may be benchmarked against the performance of facilities in this sector in developed countries through consultation with published sources (e.g. US Bureau of Labor Statistics and UK Health and Safety Executive)[23].

Occupational Health and Safety Monitoring

The working environment should be occupational hazards relevant to the specific project. Monitoring should be designed and implemented by accredited professionals[24] as part of an occupational health and safety monitoring program. Facilities should also maintain a record of occupational accidents and diseases and dangerous occurrences and accidents. Additional guidance on occupational health and safety monitoring programs is provided in the **General EHS Guidelines**.

[23] Available at: http://www.bls.gov/iif/ and http://www.hse.gov.uk/statistics/index.htm

[24] Accredited professionals may include Certified Industrial Hygienists, Registered Occupational Hygienists, or Certified Safety Professionals or their equivalent.

3.0 References and Additional Sources

Clark, J.R. 2000. Service Guidance on the Siting, Construction, Operation, and Decommissioning of Communication Towers. Personal communication from Clark (Director, US Department of Interior Fish and Wildlife Service, Washington, DC) to Regional Directors (US Fish and Wildlife Service). Available at http://www.fws.gov/migratorybirds/issues/towers/comtow.html

European Parliament and Council of the European Union. Directive 2004/40/EC of the European parliament and Of the Council on the minimum heath and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields). 18th individual Directive within the meaning of Article 16(1) of Directive 89/391/ECC. Available at http://europa.eu.int/eur-lex/pri/en/oj/dat/2004/l_184/l_18420040524en00010009.pdf

European Union. 2003a. Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment. Available at http://ec.europa.eu/environment/waste/weee_index.htm

EU. 2003b. Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE) - Joint declaration of the European Parliament, the Council and the Commission relating to Article 9. Available at http://ec.europa.eu/environment/waste/weee_index.htm

International Agency for Research on Cancer of the World Health Organization (WHO). 2002. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Volume 80. Non-Ionizing Radiation, Part 1: Static and Extremely Low-Frequency (ELF) Electric and Magnetic Fields. Summary of Data Reported and Evaluation. Lyon, France: IARC. Available at http://monographs.iarc.fr/ENG/Monographs/vol80/volume80.pdf

International Commission on Non-Ionizing Radiation Protection (ICNIRP). 2003. Exposure to Static and Low Frequency Electromagnetic Fields, Biological Effects and Health Consequences (0-100 kHz). Review of the Scientific Evidence and Health Consequences. Bernhardt, J.H., Matthes, R., McKinlay, A., Vecchia, P., Veyret, B. (eds.). ICNIRP.

ICNIRP. 2001. Review of the Epidemiologic Literature on EMF and Health. Environmental Perspectives 109 (Supp 6): 911-934. Available at http://www.icnirp.de/documents/EPIreview1.pdf

ICNIRP. 1998. Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz), Health Physics Vol. 74, No 4, pp 494-522. Available at http://www.icnirp.de/documents/emfgdl.pdf

ICNIRP. 1996. Health Issues Related to the Use of Hand-Held Radiotelephones and Base Transmitters, Health Physics, Vol. 70, No.4, pp 587-593.

Institute of Electronics and Electrical Engineers. 2005. Standard C95.1-2005: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300GHz. Piscataway, NJ: IEEE.

London, S.J., et al. 1994. Exposure to Magnetic Fields Among Electrical Workers in Relation to Leukemia Risk in Los Angeles County. American Journal of Industrial Medicine. l994:26.p.47-60.

Manville, A.M., II. 2005. Bird Strikes and Electrocutions at Power Lines, Communication Towers, and Wind Turbines: State of the Art and State of the Science – Next Steps Toward Mitigation. Bird Conservation Implementation in the Americas: Proceedings 3rd International Partners in Flight Conference 2002. C.J. Ralph and T.D. Rich, eds. United States Department of Agriculture (USDA) Forest Service, GTR-PSW-191. Albany, CA: USDA. Available at http://www.fs.fed.us/psw/publications/documents/psw_gtr191/Asilomar/pdfs/1051-1064.pdf

United Kingdom (UK) Health and Safety Executive (HSE). http://www.hse.gov.uk/statistics/index.htm

UK National Radiological Protection Board (NRPB) (now the Radiation Protection Division of the Health Protection Agency). Advisory Group on Non-Ionising Radiation (AGNIR). 2001. ELF Electromagnetic Fields and the Risk of Cancer: Report of an Advisory Group on Non-Ionising Radiation. Didcot, UK: NRPD.

United States Department of Labor, Bureau of Labor Statistics (US BLS). 2004, Census of Fatal Occupational Injuries (CFOI), Annual data from CFOI, Industry by event or exposure, 2004. Washington, DC: US BLS.

US BLS. 2004. Workplace injuries and illnesses in 2004, Incidence rate and number of nonfatal occupational injuries by selected industries in 2004. Washington, DC: US BLS.

US Department of Labor Occupational Safety and Health Administration (OSHA). Regulations (Standards – 29CFR) 1910.268 - Telecommunications. Washington, DC: OSHA. Available at http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9867

US National Institute of Environmental Health Sciences (NIEHS) and National Institutes of Health (NIH). 2002. EMF Questions and Answers. Electric and Magnetic Fields Associated with Use of Electric Power. Available at http://www.niehs.nih.gov/emfrapid/booklet/emf2002.pdf

NIEHS. 1999. Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields. NIM Publication No. 99-4493. Research Triangle Park, NC: NIEHS.

WHO. 2006. International EMF Project. Model Legislation for Electromagnetic Fields Protection. Geneva: WHO. Available at http://www.who.int/peh-emf/standards/EMF_model_legislation%5b1%5d.pdf

WHO. 2005. Fact sheet No 296. Electromagnetic Fields and Public Health: Electromagnetic Hypersensitivity. Geneva: WHO. Available at http://www.who.int/mediacentre/factsheets/fs296/en/

WHO. 2004. Workshop on Electrical Hypersensitivity. Workshop Summary, Working Group Meeting Report, Rapporteur's Report. Prague, Czech Republic, October 25-27.

WHO. 2002. Statement WHO/01, 23 January 2002, Clarification of mooted relationship between mobile telephone base stations and cancer. Geneva: WHO. Available at http://www.who.int/mediacentre/news/statements/statementemf/en/index.html

WHO. 2000. Fact sheet No 193. Electromagnetic Fields and Public Health: Mobile Telephones and their Base Stations. Geneva: WHO. Available at http://www.who.int/mediacentre/factsheets/fs193/en/

WHO. What are electromagnetic fields? Geneva: WHO. Available at http://www.who.int/peh-emf/about/WhatisEMF/en/

Annex A: General Description of Industry Activities

Telecommunication Systems

Telecommunication is the common description for technology enabling two-way communication between parties located at distances from each other. Telecommunication also comprises one-way communication technology such as television and radio broadcasting.

Wire line Systems

Telecommunication systems may be of wire line or wireless types. Wire line sites in general consist of a base station and switches connected to a network of telecommunication cable lines either installed as air cables or as ground-based cables installed in trenches. The cables may be of copper, or in recent years, fiber optical cable that enhances the communication speed and capacity of the system. A wire line system may be used for a fixed telephone system or for broadband and internet systems purposes. A wire line system is often used as a backbone system for wireless systems to provide high capacity and redundant traffic security in communication between the main switches of such a system.

Wireless Systems

Wireless systems, or cellular systems, are typically designed in the same way as wire line systems. However, the actual transmission of telecommunication signals is managed through Radio Frequency (RF) energy. A typical cellular telecommunication network consists of a number of base stations. Each base station is designed to serve a geographical area of network coverage and may be referred to as a cell in the total telecommunication network. The size of such a cell is dependent on the type of telecommunication system and the installed equipment. For example, the Global System for Mobile communications (GSM) system transmits on a lower frequency, 900-1500 Mega hertz (MHz) in comparison to the 3G system which transmits on a frequency in the range of 1500-2000 MHz. A lower frequency, as for the GSM system, generally provides the telecommunication system antennas with a wider coverage thus requiring fewer base stations compared to a system transmitting at a higher frequency. However, the high frequency and the shorter wavelengths of a denser network provide a higher capacity for data transmission which is one of the benefits of the new 3G system.

In order to achieve best possible coverage and microwave link transmission conditions, antennas are typically mounted on rooftops, masts, or other similar high structures. The heights at which the antennas are mounted vary from 15-90 meters depending on the topography of the terrain and on the radio signal coverage requirements in the area. To achieve the best coverage these antennas emit RF beams which are very narrow in the vertical direction, but very wide in the horizontal direction. The vertical direction and ground coverage is achieved by tilting the antennas forward a few degrees. The RF fields decrease rapidly when moving away from the antennas.

The signal transmission, or voice and data traffic, of a cellular telecommunication system may be divided into two parts. One is the communication between the base stations. Instead of the wire line system using copper or fiber optic cables, microwave link antennas are used as means of transmission. One base station is linked to the next by a microwave link creating a microwave-linked network enabling all base stations to communicate with each other and the major switches.

The signal transmission to the system end user, the person using the system to place a telephone call, is managed by RF antennas. The antennas communicate with the cellular handset by RF energy and the telecom equipment installed in the base station relay the call to switches located in the network and thereafter the call is rerouted to the recipient. To be able to locate the recipient of a cellular call the telecommunication system is, at all times, keeping track of all cellular handsets in the systems and where each handset is located. When a handset is moving from one cell (or base station) to another, the system records the transfer and identifies the handset as part of a new cell. In this way, the system is able to manage incoming calls and reroute them to the right base station and, subsequently, to the call receiver.

Typical cellular telecommunication sites are roof top sites and greenfield sites. A typical roof top site is located on the roof of a building with the antennas mounted on short poles or tripods on top of the roof. The equipment room is normally located inside the building, preferably in the attic or in the basement. The power supply for a roof top site is generally provided though the building landlord. This is the most common site type in urban areas.

In rural areas, greenfield sites are the most common type. The antennas are mounted on top of masts or towers instead of buildings. The typical greenfield structure, in terms of masts and towers, consists of galvanized steel towers or guyed steel masts. The equipment room for a greenfield site is a prefabricated shelter placed on a concrete foundation. The footprint of a greenfield site is approximately 200 square meters. In many cases, a new access road must be constructed for site access.

The RF antennas and microwave link antennas are connected to the telecommunication equipment by feeder cables. These cables may be installed in shafts or cable ducts on roof top sites or attached to the steel structures of a mast or tower for greenfield sites.

Another application of wireless communication is the use of satellite systems. These systems may operate independently of any fixed installations and enables the user to receive and send information regardless of their geographical location. The mobile units may be installed onto vehicles or designed as briefcases or backpacks. Fixed satellite system stations may be installed for various uses such as broadcasting applications with up-links and down-links, and analogue / digital television distribution.

The technology used for satellite communication is in essence identical to the one used for microwave links used for cellular telecommunication. The output power is higher, reaching up to 600 Watts (W). The frequency is also higher, around 14 Giga hertz (GHz). The hazards related to satellite systems are identical to those identified for any wireless telecommunication system.

Broadcasting Systems

Television and radio systems are typically designed as cellular telecommunication systems, with a few major exceptions. Communication is directed one way and the radio frequency antennas providing the television or radio coverage transmits on a lower frequency, thus creating a longer wave length. In addition, the transmission energy is considerably higher than for a cellular system enabling the signal to reach all receivers in the populated areas. Due to the high output energy and long wavelength, fewer transmission stations are required.