1 Executive summary

The global burden of cancer is increasing, especially in the developed world. Globally one in two men and one in three women will be diagnosed with cancer during their life time, for one of three of these women the diagnosis will be breast cancer. Annually, around 10 million people worldwide will be diagnosed with cancer and a total of 28 million people are currently cancer patients. The World Health Organization (WHO) estimates that the worldwide cancer rates are set to increase by as much as 50 % within a decade unless further preventive measures are put into practice. Preventive measures could include reduction in the involuntary exposure to environmental contaminants. According to the European Environment and Health Action Plan 2004–2010 it is estimated that each year thousands of city dwellers across the EU die prematurely due to air pollution and that one-sixth of the total burden of death and disease in European children can be attributed to environmental factors. The role of environmental parameters in the societal cancer burden is currently estimated to be approx. 5 %. However, some 40 % of the total cancer burden is still unaccounted for – so the contribution could be larger than 5 %. Cancer aetiology is complex, multi-causal, there can be up to decades between exposures and effects and the actual diagnosis. The cancer incidence rate increases exponentially with age.

The total cancer incidence rate in Gibraltar is within the normal ranges of other European countries. Gibraltar is not a high-risk community for cancer. Breast cancer is however in the upper centiles among EU countries and is a priority cancer type. Moreover, measured exposure concentrations of carcinogens in the air pollution exposures in Gibraltar are within the normal ranges of EU cities. Exposure to carcinogenic compounds is always associated with a cancer risk, typically expressed as a 1:10,000 person risk, since these carcinogens are characterized by their lack of thresholds, i.e. any exposure, in principle one molecule, may cause cancer. Measured concentrations of the carcinogens PAH, arsenic and nickel in Gibraltar ambient air reach levels that may increase the 1:10,000 person risk in Gibraltar.

Modeling of industry emissions in the Bay Area and diffuse emissions from adjacent Spanish municipalities shows that the contribution to ambient air in Gibraltar from industrial sources exceeds that from the diffuse sources. There is, moreover, a decrease in annual mean air concentrations from industrial emissions between years 2005 and 2008. Modeling reveals that chromium in the Gibraltar air is potentially close to the 1:10,000 risk value. No measurements have been made on chromium.

Ambient air PAH, arsenic, nickel, and chromium are priority pollutants. The primary emitters of carcinogenic air pollutants are the nearby industries in Spain (CEPSA, Acerinox, Interquisa, Petresa, Lubricantes del Sur, Edar de la Linea de la Concepcion). Carcinogenic pollutants contributions from CEPSA flaring, ship traffic in the Bay and Straits, local road traffic and local diesel generators are currently un-quantified due to lacking emission data on carcinogens.

2 Conclusions

These are the questions we were asked to address:

1. *To establish whether there actually exists a greater than expected incidence of cancer in Gibraltar.*

Re 1) The total cancer incidence rate in Gibraltar is within the normal ranges of other European countries (Figure 3.14– 3.16, page 60-62). Hence, the incidence of cancer is not greater than expected.

The incidence rate is highly dependent upon the age structure of the population. The changes towards less young and older persons in Gibraltar will over time contribute significantly to the increasing cancer incidence rate. This does however not explain the trend over the past 5 years, with increases and decreases of up to 30 % in total cancer incidence rates between years (Figure 3.5, page 50). The reason behind these fluctuations is among other things the relatively small numbers and population, by the law of large numbers. Even if the 13% of uncertain files as explained in paragraph 4.2 on page 48 were all cancer cases with the same distribution among types as the rest of cancer in the registry this would not change the overall conclusions that Gibraltar is within the normal range of cancer incidents rates in the EU as evident from the figures 3.14 to 3.31.

2. *To establish whether Gibraltar is a high-risk community for cancer, due to its location within the vicinity of potential sources of environmental exposure or health hazards, which potentially result in unacceptable levels of exposure to contaminants or pollutants.*

Re 2) As shown under 1) Gibraltar is not a high-risk community for cancer in general as the incidence rates are within the normal ranges of the EU. Moreover, the exposures in Gibraltar are within the normal ranges of EU cities (Table. 4.1, page 84).

Gibraltar is however, an urban environment with emissions and therefore exposures to contaminants from anthropogenic activities, hereunder industries and transport. For the most part these exposures comply with Gibraltar and international guideline values and thresholds. Exposure to carcinogenic compounds is always associated with a cancer risk, since these compounds are characterized by their lack of thresholds, i.e. any exposure, in principle one molecule, may cause cancer. We have shown that there are carcinogens (PAH, arsenic, nickel) in the ambient air that may reach exposure levels that will increase the 1:10,000 person risk. The definition of a high-risk community is a risk management definition, of what is acceptable and what constitutes a high/unacceptable risk. It is well-known that the environment does impact the cancer risk in the general population, and that air pollution, all other factors being equal, is the most significant vector for environmental cancer risks. Moreover, that the main exposure route is thus the respiratory system and the greatest risk is thus lung cancer. The cancer incidence rates for lung cancer is relatively low in Gibraltar compared to the rest of the EU (Figure 3.17-3.19, page 63-65), suggesting that other countries are typically of greater risk for lung cancer and that Gibraltar therefore is a relatively lower-risk community.

3. *Is there a correlation and possible causation between observed environmental pollutants and increased incidence rates of cancer*?

Re 3) The causation of cancer is complex, multi-causal and long term. At a societal level the cancer incidence rate is highly dependent upon age-structure and demographics. Breast cancer is

the cancer type that has the most significant relative elevated cancer incidence rate in Gibraltar compared to the rest of the EU. The causes of breast cancer are multiple, hereunder air pollution (Breast cancer fund, 2010). As pointed out in relation to the above questions Gibraltar has relatively normal range cancer incidence rates, and the environmental exposures are also within the normal ranges for urban European environments. There are exposures to carcinogens, like in most other areas in the EU, and these will increase the risk cancer as they do in the rest of the EU. However, quantifying the correlation and assigning causation is currently not supported by the available data U.S. Presidential Cancer Panel, 2010).

4. *Is there an increased rate for a certain type of cancer that could be linked to environmental pollutants*?

Re 4) The direct comparability of the cancer incidence rates is impaired for most of the minor cancer types due to small numbers in Gibraltar (typically 0-2 cases per year). Hence, we can primarily compare the few larger cancer types that combined represent >50 % of the total cancer incidences. The larger cancer types incidence rates were generally relatively low in Gibraltar compared to the rest of the EU, with breast cancer as the exception, which is in the upper centiles among EU countries. The relatively elevated breast cancer incidence rate (elevated compared to the rest of the EU, but still within the normal range) is potentially linked to the exposures to priority pollutants such as PAH, arsenic and nickel via air which will contribute to the cancer risk in general, hereunder breast cancer.

5. *What is the pathway for exposure, e.g. drinking water or air pollution*?

Re 5) The primary exposure route is air, with PAH, arsenic and nickel, and potentially chromium as the priority pollutants (Table 4.1, page 84).

6. *If there are environmental cancer risks due to pollutants are these related to specific activities in the area*?

Re 6) The primary emitters of carcinogenic air pollutants are the nearby industries. Currently un-quantified emissions from local road traffic, ship traffic, local diesel generators and CEPSA flaring in Spain also contribute. CEPSA, Acerinox, Interquisa, Petresa, Lubricantes del Sur, Edar de la Linea de la Concepcion are the primary quantifiable emission sources for the recorded ambient air carcinogens.