

## CONCLUSIONS

In this project, I analyzed the social, cultural, technical, industrial and scientific feasibility of a large population living onboard a space colony. The minimal population in order to ensure self-sustainability of the colony has been determined as of the order of 100'000 people.

The importance of correctly determining the population growth for the settlement has been stated. Population growth is an important concern in order to determine both how a society will evolve and how much space it will need for extension. I have shown that, though predictions may be made based on known growth models (Malthusian, von Foester and Verhulst), there is no certainty that these predictions are accurate. That is due to the fact that we do not have any experimental data for large populations living in closed environments (such as a space colony) – and thus we do not know which are the accurate parameters for the Foester or Verhulst models.

The proposed development plan includes the construction of a lunar extraction and processing facility and a two-phase construction of the space settlement. The main reason for constructing first a lunar extraction facility is an economical one. Extraction facilities may also be placed on asteroids and comets, as described in the previous project SEEDS (2004). Proposing a rational supplies management is effective in minimizing costs. The supplies' need is considered in direct relationship with industrial development.

Safety was considered an important aspect. In the proposed schedule, sufficient amounts of time have been allocated for checking the equipment and structure.

Two goals were satisfied by the proposed schedule. The first goal was to ensure the physiological requirements for a 10'000 population that may gradually develop economy (first construction phase, 4-5 years). The second goal was to insure self-sustainment from physiological, social, economical, educational and scientific points of view for a 100'000 final population (proposed completion time of maximum 10 to 15 years).

Nutrient requirements are considered in this project as guidelines for ensuring healthy diets for people living onboard a space colony. I provided an analysis of the nutrient requirements for different activity profiles and I determined the oxygen consumption.

A model for the water consumption of the settlement has been proposed, considering both the requirements of a permanent space station and the per capita needs of citizens living in Canada and England. The proposed model states that people onboard the settlement must have a normal life – including a reasonable comfort. Moreover, the water consumption per capita should include the needs of agriculture and industry – aspects not properly covered by previous designs.

Water quality and monitoring has been discussed, along with an analysis of previously proposed water disinfection methods (including methods used in space applications).

A thorough study of passive shielding techniques for space applications has been made. It includes a general problem statement and particularizations of shield shapes based on the irradiation geometry. I have proved that the radiation distribution is not uniform inside the shielded area (an aspect neglected by previous designs). This has an influence on how the population/equipment is distributed inside the shielded area.

I restate that this project is part of a whole (TEBA, 2003; SEEDS, 2004 and TEMIS, 2005) and that general aspects were covered by the two previous designs. This project focused on providing a realistic, scientific analysis of problems that were not, or were scarcely analyzed in the literature.

#### FURTHER WORK

As shown in the first chapter, there is a degree of uncertainty in predicting the population growth of a space colony. The relationship growth-development and growth-resource depletion has to be analyzed for a large population in a closed environment (such as the space colony) in future studies. Predictions of the colony's population growth are hindered due to lack of experimental data, as the parameters for the Foester or Verhulst models may not be the same as for the US population or other countries. The conditions differ – the colony comprises a large population in a closed environment. Experimental data will have to be gathered based on, for example, the development (growth) ratio for the first space colony, or on small isolated populations on Earth. Until experimental data on this topic is available, our predictions will remain at the state of approximations.

The nutrient requirements' analysis did not include the actual diet – in terms of aliments. Another problem is how to store the high quantity of water required for a 100'000 population. Further work would also include detailing the usage of ozone as a disinfectant, an aspect neglected because disinfection by-products are not known precisely for ozone. Thus, I was not able to determine the benefits and disadvantages of using ozone as a water disinfectant.

A paper continuing the work on radiation shielding (presented in chapter IV) has been written (in collaboration) and has been submitted to a conference (the paper is now under refereeing process). The paper covers the problem of a uniform circularly distributed source and the radiation distribution inside the protected area for a shield shape corresponding to this irradiation geometry. The case of secondary radiation (neglected in this project) has been discussed in that paper.