

## Health & Safety Requirements for Space Resource Workers

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Protecting space workers from the inherent hazards of space is going to be a formidable task. Safe guarding workers performing historically dangerous work (mineral extraction) will present additional hazards, which we can only imagine at this place in time. Until we actually begin extracting resources in space, we need to make intelligent assumptions and assume scenarios for the hazards. Protecting people and material resources is in the best interests of any enterprise as catastrophic failure could easily lead to total bankruptcy – not to mention the failed opportunity.

In space we will encounter situations beyond our present knowledge; however, many of the situations will be similar to our experiences here on Earth.

### Similarities (with Earth experiences)

1. Eighty percent of accidents are directly caused by human error.
2. Earth-based extractive industries are generally considered high hazard occupations.

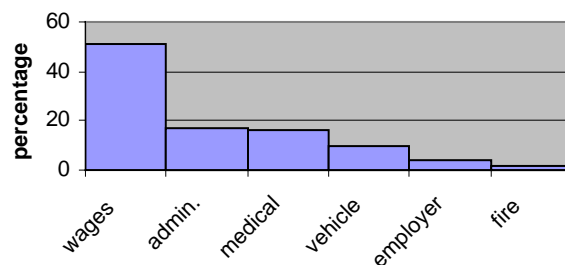
### Differences (in Space)

1. Space-related accidents have the potential to be catastrophic.
2. Simple health problems can be life threatening or catastrophic.
3. Simple injuries can be life threatening or catastrophic.

On Earth all accidents have a financial liability associated with them. The easiest one to calculate is catastrophic failure whereby the project costs may be recouped by insuring the project.

Unintentional accidents and disease are a part of life on Earth as will be the case in space:

**Unintentional Injuries (US-1997)**  
**\$487.3 Billion**



In space, Medical emergencies will present situations beyond our immediate control. Situations, such as: the one which occurred in the Antarctica in the summer of 1999 where a woman developed a lump in her breast and was at first denied medical help due to her isolation of her situation, will occur again. Only minimal emergency and treatment centers will exist in space, at least initially.

As we gain experience in near space, we will be presented with new situations requiring corrective procedures. A recent incident on the international space station documented that carbon dioxide was present in some parts of the station under construction. Maintaining a healthy environment in an isolated environment, like space, is an area well known to the minerals industry, submarine technology and the space industry. Space resource development

will present its special problems due to the nature of the industry.

Accidents may be due to three major causes: environment, machinery and human.

Hazards anticipated in space are similar, and in some cases drastically different, to what workers are confronted with here on Earth:

### **Types of Accident**

- machinery
- power / electrical
- gases
- chemical
- environment
- slips & falls
- hand tools

### **Resulting Injuries & Health Hazards**

- cuts / bruises / fractures
- burns
- explosions / suffocation
- respiratory diseases
- disabling skeletal disorders

In space, as on Earth, focus will be in the following areas:

1. construction: site preparation
2. extraction: removing a valued material from its surrounding
3. final processing & shipping: value-added additions and delivery to customer

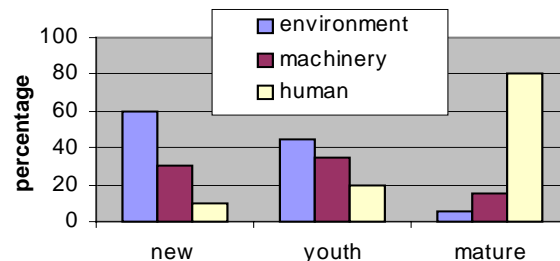
Accidents involving injuries and health threatening situations are unavoidable. In the remoteness of space, many things will need to be done differently than on Earth due to the more confined environment and the unavailability of resources present on Earth.

Even simple medical procedures can not now be performed in space, such as, an appendectomy.

In space, even a minor accident may precipitate catastrophic consequences resulting in immense financial loss and possible loss of life. It is in the best interest of all parties involved in mineral extraction and beneficiation in the space environment to identify all potentially hazardous conditions involving equipment, material and workers. It is also in everyone's best interest to use the best Earth-based engineering practices available to eliminate or minimize hazardous situations and through careful training, prepare all workers to respond quickly to emergency situations to mitigate damage and injuries.

Mining is a mature industry. With the initiation of space resources extraction,

### **Stages of a Process**



environmental factors will be the initial concern.

We are transferring one of the most dangerous industries on Earth to the most hostile environment in the universe. Is this cause for concern? Yes! Is it cause for despair? We think not! We have the expertise, knowledge and technology to safeguard workers in one of the most inhospitable environments known to mankind.