



NEWS RELEASE

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Factsheet - Underground Ammunition Storage

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Advantages of Underground Storage

The use of underground rock caverns to store ammunition will release valuable land above ground for other uses, and allow MINDEF to develop and apply cavern technology in its design and construction.

An underground ammunition facility offers other advantages:

- Safety is greatly improved because the rock mass is able to confine and reduce the effects of accidental explosion.
- Underground installations in rock provide excellent protection against various types of weapons, compared to conventional protection of aboveground installations by reinforced concrete.
- Underground installations offer effective concealment from sight, hence ensuring higher survivability.
- The relatively constant temperature underground is very suitable for ammunition storage.
- Rock caverns can have almost unlimited life span, compared to aboveground structures which are subject to the effects of weather.
- The cost of the installation over its life cycle will be lower, due to lower operating and maintenance costs.

Considerations for Design

Designing and developing an underground ammunition storage facility requires expertise in three specialised areas:

- Ammunition Safety. In the unlikely event of an accidental explosion, the design must ensure the safety of its surroundings.
- Protective Design. The design must be able to survive any foreseeable weapons attack. Important openings and entrances must be protected against external attack.
- Rock Engineering. Cavern design has to overcome the engineering uncertainty in the structure of the rock mass, formed millions of years ago, and subject to complex variations due to weather and other factors through the ages. Specialised technology in site investigation and rock engineering are required in the design and development process.

Technology Development

The development and application of leading-edge technologies is an important factor in the successful construction of the underground ammunition storage facility. MINDEF has been pioneering research on water mitigation and ground shock studies. (Water mitigation involves the use of water to absorb the energy of an accidental explosion, while the latter concerns the analysis, prediction and minimisation of ground shock effects.) These theoretical studies, coupled with laboratory and field explosives testing, will minimise the risk and effect of accidental explosions and greatly reduce the land area sterilised by possible explosive effect. It will also enable inhabited buildings to be constructed closer to the ammunition depot safely, thus saving more land.

MINDEF Project Team and Partners

A MINDEF Project Team worked with both local and foreign partners on this project. The Project Team includes engineers from the Lands & Estates Organisation (LEO), the Defence Materiel Organisation (DMO), the Resource Planning Office (RPO) and military officers from the Singapore Armed Forces (SAF). The Project Team worked closely with Singapore's Institute of High Performance Computing and the protective technology centres at the two local universities. They also tapped know-how and expertise from US, Norwegian and Swedish defence construction and research organisations through joint development and consultancy services. These included Sandia National Laboratories and Defence Threat Reduction Agency (DTRA) from the United States, Norwegian Defence Construction Service (NDCS) and Norconsult International (NI) from Norway and Defence Research Establishment (FOA) from Sweden.

News Release:

- MINDEF Constructs First Underground Ammunition Facility (Document No: MINDEF_19990812001.pdf)

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