

ILC-CR-0020: SRF Accelerator Cryogenics: He Inventory storage

Panel review summary

The change request assumes that the ILC site may potentially suffer from a full electrical power outage from the main supply station for more than three days.

No financial aspects are taken in account in the below analysis, only technical aspects have been discussed by the review panel.

As a general preamble, it will be advisable that the ILC site foresees an electrical supply backup from a second and independent from the main supply station, able to maintain an automatic power transfer for the safety and a reduced number of necessary equipment; if the ILC250 may require 100-120 MW for nominal operation, the independent backup may be dimensioned for a supply of 10-20 MW. In this backup configuration a very reduced number of cryogenic equipment may be re-supplied electrically thus allowing the smooth recovery of the helium inventory from the accelerator (and therefore either allowing storage in gaseous phase in the nominal cycle gas tanks at 20 b or re-liquefying part of the gas in dedicated liquid helium storage tanks).

Regarding the Change Request proposal, from a cryogenic process perspective, helium gas-only storage such as in 20 bar tanks, filled during a power outage via a recovery compressor on temporary backup power, makes good sense. This provides a storage method which, after recovering the helium from the accelerator, would not need further electrical power to maintain storage for some additional days. Additionally, by adjusting the recovery compressor capacity (flow rate) to the vaporization rate will also result in electric power saving during the backup configuration.

This proposal will require the implementation in the tunnel vicinity of atmospheric or electric Heat Exchangers and a Helium Recovery Line connected to the recovery compressor (or compressor station). Additional study should be done regarding the mechanical and civil construction implications for the additional equipment in the tunnel infrastructure.

In the proposed Change Request, the footprint of the gas tanks batch per point seems to remain identical to the previous one, by going underground for one or two layers of gas tanks. Additional study should be done regarding the mechanical and civil construction implications for the additional gas tanks to be implemented. Obviously, liquid helium storage allows smaller footprint for equal mass of helium relative to gas storage (and less units of tanks). In the case of full gas storage of the inventory, the space required and the visibility of large gas tanks from neighboring areas can force to limit their use.

This latter issue would be a site-specific concern (Kitakami site). Some access points are between the mountains, some are at the edge of the residential area. The appearance of the large helium storage tanks must be seriously considered. It appears necessary to secure the degree of freedom allowing the position of the tanks to be moved by several hundred meters. This approach applies not only to the newly proposed full gaseous storage concept, but also to the present baseline concept with 50% of the helium inventory in liquid phase.

Executive summary:

- From a cryogenic process perspective, helium gas-only storage such as in 20 bar tanks, filled during a power outage via a recovery compressor on temporary backup power, makes good sense.
- Additional studies have to be conducted on tunnel integration of new equipment, mechanical and civil construction as well as environmental integration and location of the helium gas tanks batches in the proposed sites.
- No financial aspects have been examined by the panel.

Nota Bene 1

Some of the panel members are not familiar with the Japanese rules and regulations; Legal clarifications required by local experts:

On advice from our Japanese panel colleagues it appears that the new full gaseous storage proposal will have a different treatment from the point of view of the applied regulations. The new proposed scheme will be controlled by rules for refrigerators. The present base line scheme with 50% of liquid helium storage using a dedicated liquefier and tanks will be controlled by the safety regulation for general high-pressure gases. The latter regulation requires internal visual examinations.

Nota Bene 2

In all cases, during normal operation periods, as helium supply to the ILC site from industrial contractors will mainly be performed by means of liquid helium 11'000 US gallons ISO-containers (pressurized or not), a minimum infrastructure of liquid helium storage tank(s) in situ may be required