8.6 NB Injector Maintenance Equipment

8.6.1 Function, Basic Configuration and System Boundaries

The main function of the NB injector maintenance equipment is to provide routine maintenance of the NB injectors. Routine maintenance is needed for the replacement of ion source filaments, replacements of the cesium oven and removal of cesium from the accelerator grids and insulators. The RH class, and intervention frequency and durations for the NB injector maintenance equipment are given in Table 8.6-1.

Table 8.6-1 NB Injector Maintenance Equipment Requirement

Category/Item	RH Class/Frequency/Duration
Design Requirement	
NB cesium cleaning	RH Class/2, Frequ./1 per year, Intervention Time/17 days
NB fast shutter	RH Class/2, Frequ./1 per year, Intervention Time/17 days
NB front liner	RH Class/2, Frequ./1 per year, Intervention Time/17 days

8.6.2 Requirements

8.6.2.1 Environmental Conditions for NB Injector Maintenance

The RH equipment shall be compatible with the following environmental conditions.

Table 8.6-2 Environmental Conditions

Items	Description	Design Conditions
1	Pressure	0.1 M Pa
2	Vent/purge gas	Air
3	Temperature	Ambient
4	Radiation (preliminary estimate; 10^6 s after shutdown.)	- Around ion source: 1 Sv/h - Outside the ion source vacuum boundary: 10^{-2} Sv/h - Outside the beam line: 10^{-2} Sv/h - Outside the magnetic shield: 10^{-4} Sv/h - Around fast shutter: 10^{-1} Sv/h
5	Magnetic field	Zero

8.6.2.2 Maintenance

NB maintenance equipment shall be designed to operate for the NB injector maintenance duration. This includes periodical maintenance between in-service inspections.

8.6.2.3 Hands-on

Only rescue activities are performed hands-on. Scheduled NB injector maintenance activities

are performed remotely.

8.6.2.4 Reliability

The NB injector maintenance equipment design shall include failure modes and effects analysis and concomitant repair strategies. The failure rate for modes which could result in damage to the vacuum vessel boundary or the primary coolant boundary, shall be less than 10^{-6} times per plant life.

8.6.2.5 Durability

NB injector maintenance equipment shall be designed to withstand the environmental conditions described in 8.5.2.1.

8.6.2.6 Access

Only rescue activities need accessibility for delivering tools and hands-on access.

8.6.2.7 Space

All NB maintenance equipment shall be located in the NB cask. RH activities take place within the IVV cask, and the NB port and cell. All RH equipment that has to work on these areas shall be designed to be compatible with the space available.

8.6.3 Codes and Standards

Industrial codes and standards shall be used as guidelines for the design, manufacturing and testing of the blanket remote maintenance equipment, including the following.

- Control system standards:
  - IEC 204-1, 1992: Electrical equipment of industrial machines, or
  - ANSI/NFPA 79: Electrical standard for industrial machinery
- Machinery (Robot) safety standard:
  - ISO 10218, 1992 Manipulating industrial robots. Safety, or
  - ANSI/RIA R15.06-1992 Industrial robots and robot systems. Safety requirements
- Welding & inspection: generic at the time of procurement
- Materials: generic at the time of procurement
- Standard Control system items: generic at the time of procurement