ABSTRACT

Within the framework of fusion technology research and development, a neutron source has long been considered a key facility to perform irradiation tests aiming at populating materials engineering database – supporting DEMO reactor design and licensing. New Sorgentina Fusion Source (NSFS) has been proposed taking advantage of well-established D-T neutron generators technology, scaled in order to attain a bright source of about $10^{15}$ n/sec. Actual 14 MeV neutron spectrum is a relevant feature. Ion beams of 30 A are produced and accelerated up to some 200 keV energy. Present design considers ion generators and extraction grid technology employed in neutral injectors currently utilized at large experimental tokamaks. Then deuterium and tritium ion beams are delivered to the target - impinging on a hydride thin layer which is on-line D-T reloaded via ion implantation. Metal hydride is continuously re-deposited preventing layer from being sputtered, increasing installation load factor. Large and fast rotating target is conceived to enhance heat removal - coping with thermal transients and mechanical loads. Design is aimed at achieving challenging performances regarding elevated heat flux of 60 kW/cm² and thermal fatigue concerns. Main facility characteristics are provided, as well as target thermal and mechanical issues.

**D-T fusion reactions generating 14 MeV neutrons for material irradiation**

**D⁺ - T⁺ Ion Beams Impinging Metal hydride layer as D-T enriched target**

**Hydride Target Surface**

Deuterium-tritium stocked in metal hydride form target surface

- Titanium – Erbium metal hydride: sputtering restored by on-line deposition
- D-T storage in vacuum - high temperature (up to 400 °C)
- 2 micron layer for D/T² 200 keV ions

**Design Strategy**

- Neutral beam injector systems (NBI) utilized as large area high current D/T² ion sources
- D-T ions stored in hydride metal layer on target – D-T reload via ion beams implantation
- High total current beam sputtering solved through on-line metal deposition
- High power density delivered to target managed by rotating wheel structure
- Thermal-mechanical issues approached by multi-layer design (thermal shock & substrate)

**References**

- M. Martone et al., High flux high energy deuterium ions implantation in high temperature titanium, ENEA Internal Report (1992)