Diagnostic Neutral Beam (DNB)

Short description of the package:

Role of DNB in ITER:

- DNB will be a probe beam for active Charge exchange radiation spectroscopy diagnostics (CXRS)
- Determines He ash density in the core plasma.

Specifications:

Beam voltage	100 keV (H)
Beam Current	60 A (extracted)
Modulation	5 HZ for 3 S every 20 S
Divergence	< 5 mrad (IN PT suggestion < 10 mrad – now under assessment)

Deliverables:

The DNB components to be delivered to ITER falls into two main categories:

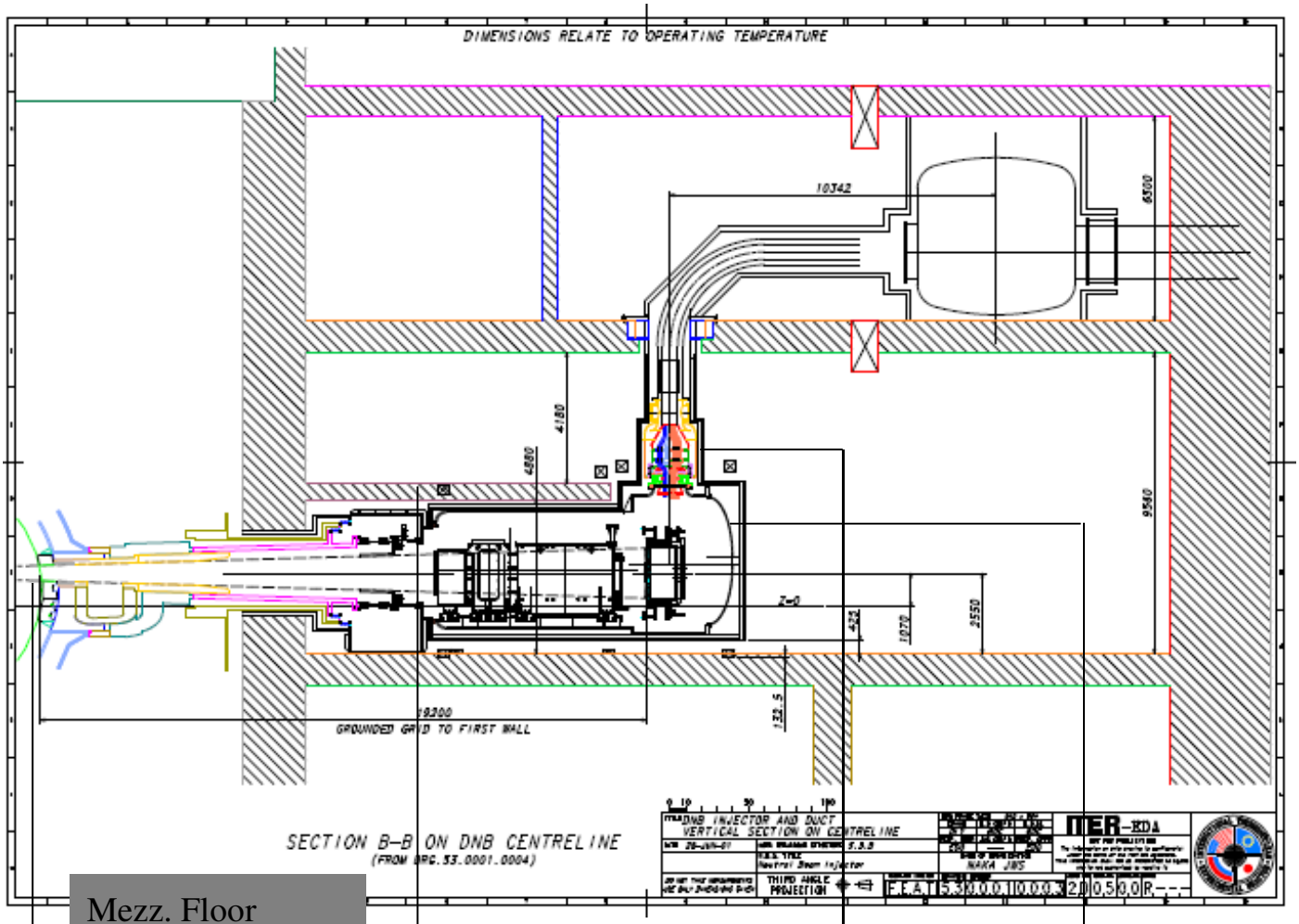
Built to print components

- **Ion source**
  - Plasma source
  - Extractor grids & support system
  - HV feed through (bushing)
- **Beam line components**
  - Neutraliser
  - RID
  - Calorimeter

Built to functional specifications

- Beam source and beam line vessels & supports
- Duct box
- Passive magnetic shields
- Active compensation coils
- Fast shutter

Ongoing Design Modifications



Mezz. Floor removed to enable top access

Design Review recommendation to re-open blanket opening

Top feed of HV modified to back end feed. RH compatibility needs assessment.

Cylindrical vessels configured to rectangular

IN PT assessment of DNB

R&D issues

Ion source

- Production of large area uniform RF plasma
- Optimal Cs Consumption
- Operational temp. of source

Extraction

- Beam divergence
- Stripping losses
- Optimal E acc & E ext

Experimental validation of RID concept

Technology development

High heat flux removal

Concepts

Dissimilar transitions

Fatigue life

Fast movement shutter

Ceramic insulator/HV feed through

Conventional technologies

Vacuum vessels

Active and passive compensation

Support structures

Implementation Strategy:

R&D issues:

Initiate in-house R&D – (2008 – 2010):

- procure scaled source to study RF produced plasmas
- perform test of concepts for extractor configurations

Join Neutral Beam Test Facility (NBTF) at Padua, Italy and carry out (2011 – 2013):

- design of ITER RF ion source (H&CD & DNB)
- experimental studies on large area RF sources
- validation experiments for extractor concepts
- Modulation experiments for DNB source

Technology development (2007 – 2009)

- Carry out preliminary design – Involve engineering services
- Place prototype contracts with industry
- Undertake process qualification trials
- Manufacture one set of prototype with specified configuration
- Carryout performance characterisation in HHF facilities (IPR/KFA-J/JET)
- Prepare a comparative assessment of manufacturing technologies
- Propose a configuration to ITER for a BTP
- Place manufacturing contracts for full size components for delivery by 2011

Conventional technologies – for vessels, ducts etc. Involves early delivery- (2010 – 2014)

- Carry out engineering design (as per standards) – with engineering services
- Review design and obtain IO endorsement on interface clearances
- Place manufacturing, inspection and commissioning contracts
- Inspect components at manufacturers site, obtain clearances from approved notified agencies
- Ship components to ITER and commission hardware

DNB schedule

General comments:

DNB required for the first plasma

Early deliveries related to vessels and relatedhardware can be met (however, additional hardware have to be created to support tests in the IN PT DNB test stand)

Delivery of injector depends onNBTF – an early start of NBTF would aid timely integration

High light of projections made to IPS:

Completion of design phase	Jan 2009
Completion of prototype activity	Dec 2008
R&D activity on ion source	2008 – 2013
Integrated testing in IN TS	Feb 2014 – July 2015
Completion of manufacturing activity	Aug 2013
Delivery to IO	March 2016
Assy. & Integration of injector at ITER	March – Aug 2016
Integration of power supplies and comm.	Aug. 2016 – July 2017

Industry interactions:

2 levels of interactions (interested # of industries in parenthesis):

Complete package delivery including assembly and commissioning at site (~ 3)

Association in the level of special technology development (~ 4)

Interactions with R&D establishments in India (Major areas):

Development of specialcopper alloys

Process qualification and process development for special technologies

QA standards for NPE standardequipment, failure analysis and risk assessments