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Scoping Studies to mitigate operational dose rate outside penetrations in B11-L3 in ITER Tokamak Complex

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B11-L3 level represents area where HV lines of Heating Neutral Beam (HNB) passes through North Wall aperture as depicted in Fig 1[1] inside ITER Tokamak Complex (TC). After North wall, outside area will be used for maintenance operations after machine shut down. For human access, the shutdown dose rate should be as per directed by ALARA outside penetrations in B11-L3 in ITER Tokamak Complex. The modelling of radiation sources (neutron, gamma, delayed gammas etc) and material activation calculation is required in order to find dose rate distribution and shielding solutions if it is more than proposed limit.

B11-L3 north wall has three penetrations for high-voltage lines of HNB and one penetration for DNB (diagnostic neutral beam line). There exist a baseline design which is being planned to be replaced with aedicule structures at openings, which will change dose received in the area due to different structural materials and layout of aedicule model. Performance of the new proposed shielding structure w.r.t. the baseline shielding is needed to be compared for safe operations. This study is performed with radiation transport code MCNP and FENDL3.1 data library [2]. The baseline model is obtained from reference MCNP model and new proposed model having aedicule structure was received from IO in STP format, their simplified version are shown in Figure 1.

Mode-0 gamma and neutron sources are modelled at the wall as disk source covering same area as of all three openings of HNB and one opening of DNB inside B11 NW with thickness of 1 cm. The isotropic gamma sources assumed at penetrations are disk sources consists of ^{16}N decay gammas with 6.128 and 7.115 MeV energies respectively and similarly neutron sources are also assumed as same size disk sources at HNB and DNB penetrations having energy spectrum of the neutron source taken from radmaps2002.

Comparative study of the shielding performance of Baseline (item#12 of PCR#1154 [3]) vs aedicule's outside north wall is performed for both Neutron and gamma sources. Aedicule model gives better dose rate reduction outside

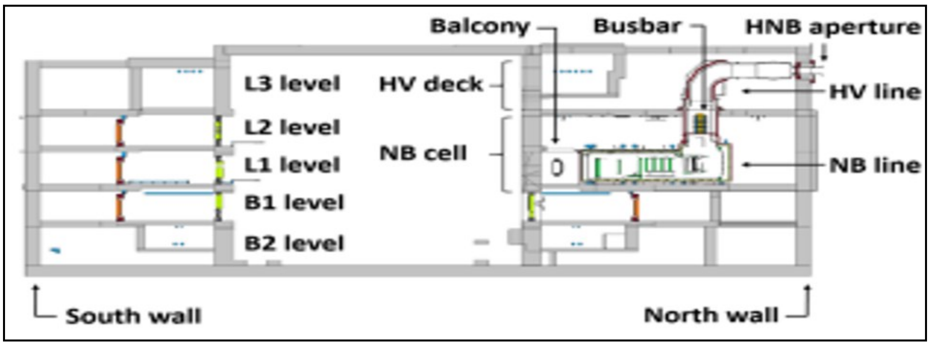


Figure 1: Vertical cross section view of ITER tokamak complex and NB Cell [1]

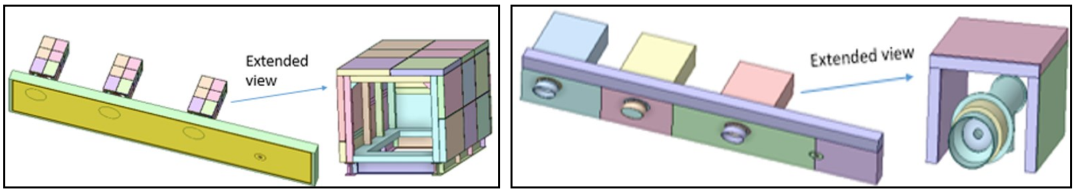


Figure 2: CAD Model of Baseline and newly proposed Aedicule model

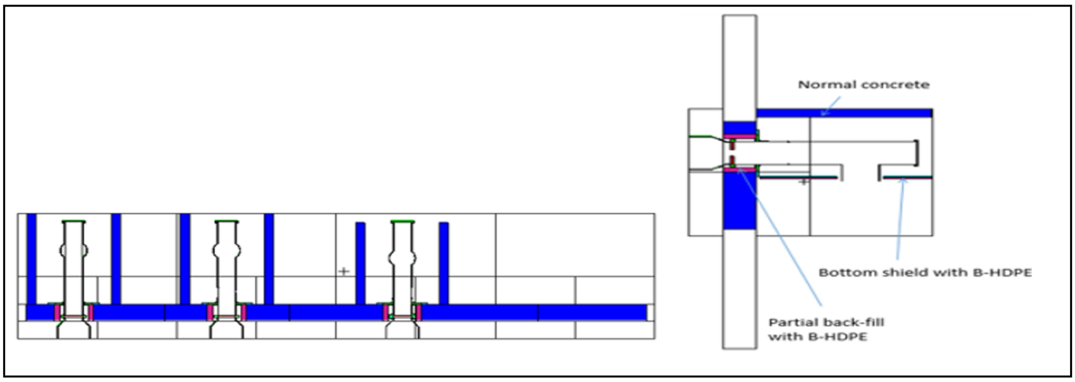
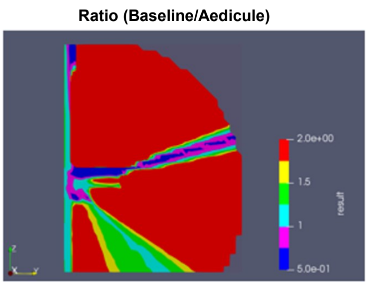
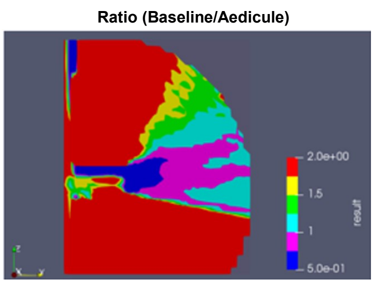


Figure 3: MCNP Model of Aedicule model in Top view and side view

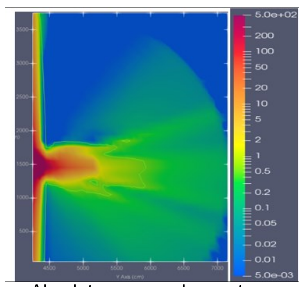
Results



Gamma dose rate ratio at HNB-1



Neutron dose rate ratio at HNB-1



Absolute gamma dose rate map at HNB-1 in adecule model

north wall as well on ground by a factor ~2 in most of the area except very small region of backside of aedicules at elevated levels of openings only in case of neutron. This is mainly due to absence of any shielding structure and few openings in aedicule model as compare to baseline model. Absolute dose rate at ground is found ~0.2 μSv/hr which is near to ALARA proposed limit.

All the simulations have been performed in ANTYA cluster facility of Institute for Plasma Research, Gandhinagar using MCNP and plotting is done using ParaView.

References:

1) Improved radiation shielding analysis considering vector calculus, Rafael Juarez et al, int J Energy Res. 2021; 45:11904-11915
2) FENDL 3.1
3) IDM UID 93932Q, The shielding assessment of the FDR design of PCR1154 items 12&20

EasyBuild vs Spack: What Users Actually Experience the Differences

Scientific software on HPC systems presents challenges such as dependency conflicts, compiler inconsistencies, and version management. Two tools - EasyBuild and Spack - address these challenges but employ distinct methodologies. This article outlines their practical differences with emphasis on user experience and workflow implications.

1. Installation Workflow

- EasyBuild relies on predefined easyconfig files (.eb) that describe the exact build procedure, compiler toolchain, dependencies, patches, and installation paths. When an appropriate .eb file is available, installation proceeds in a consistent manner with minimal intervention. The process produces a complete environment, including module files, aligned with the associated toolchain.

```
eb FFTW-3.3.10-GCC-12.2.0.eb --robot
```

- Spack uses a parameterized, directive-driven syntax where users specify versions, compilers, and build options directly on the command line. The dependency solver determines required libraries automatically, enabling high flexibility but potentially increasing build time and storage usage.

```
spack install fftw %gcc@12.2.0 +mpi
```

2. Reproducibility

- EasyBuild provides strongly reproducible builds because each .eb file and toolchain combination uniquely defines the software stack.
- Spack can produce reproducible results, but only when users explicitly lock concretization to ensure identical dependency trees.

3. Environment Modules

- EasyBuild generates structured Lmod modules by default, enabling seamless loading and unloading of software.
- Spack also generates modules, but they are often deeper due to the large dependency hierarchy created during concretization.

4. Suitability for Users

- EasyBuild is suitable for users requiring well-tested, stable software environments.
- Spack is more appropriate for users who require custom configurations, multiple versions, or experimental compiler/MPI combinations.

5. Version and Variant Management

- EasyBuild performs optimally when required versions exist in the official easyconfig repository. Multiple versions can be installed, but changes to compilers or MPI stacks typically require new .eb files.
- Spack is designed for environments where numerous versions or build configurations are necessary. Users can install multiple variants concurrently with simple parameter modification:

```
spack install python@3.11 %gcc@12
spack install python@3.10 %gcc@11
```

6. Customization vs. Standardization

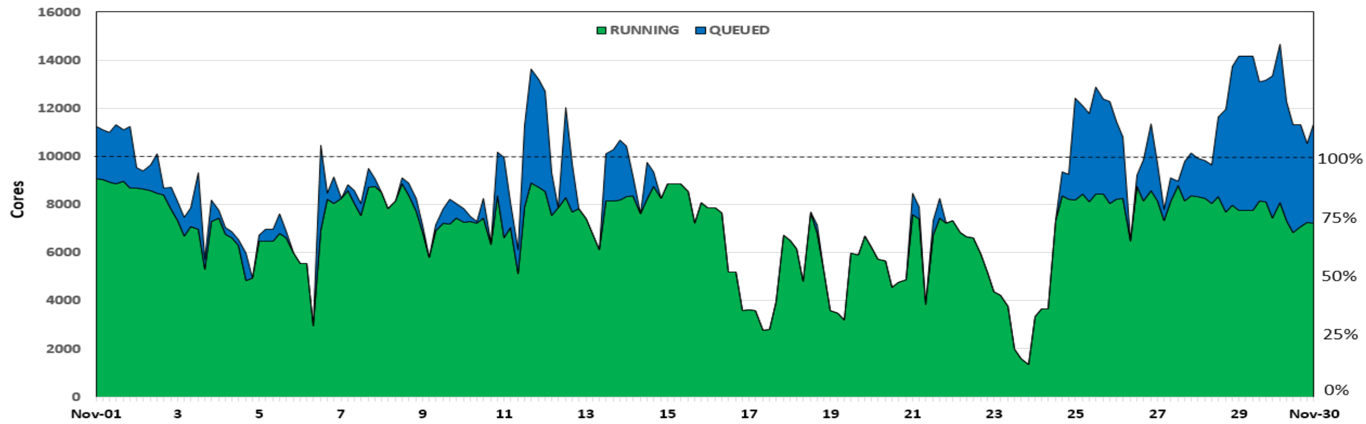
- EasyBuild emphasizes standardization through toolchains, which is advantageous for collaborative research groups and shared HPC environments.
- Spack emphasizes customization, enabling non-standard builds used in algorithm development, performance evaluation, or compiler comparison studies.

7. Build Time and Storage Considerations

- EasyBuild typically produces smaller, faster builds because toolchains and dependency sets are reused across applications.
- Spack often results in longer build times and increased storage consumption, as each configuration generates a distinct dependency tree.

Both EasyBuild and Spack are powerful tools, but they serve different user needs. EasyBuild is well-suited for users requiring stability, predictability, and reproducibility, while Spack is ideal for users requiring flexibility, customization, and a broad range of build configurations. Understanding these distinctions enables HPC users to choose the tool that aligns most effectively with their workflow requirements. User may refer previous articles on spack and easybuild here (https://www.ipr.res.in/ANTYA/)

ANTYA Utilization: NOVEMBER 2025



ANTYA HPC Users' Statistics

November 2025

Total Successful Jobs~ 1503

> Top Users (Cumulative Resources)

- **CPU Cores** Gopal Mailapalli
- **Walltime** Gopal Mailapalli
- **Jobs** Jugal Chowdhury
- **GPU Cards** Debashis Ghosh

ANTYA Usage, Updates and News

- **Scheduled Downtime**: There was no downtime of ANTYA for November 2025.
- **Job Submissions:** The highest job loads were observed in the *serialq*, *regularq*, *mediumq*, *longq and ansysq* queues, reflecting sustained user activity across multiple workloads in various queues.
- **Cluster Utilization**: The system maintained an average utilization of ~69.65% and peak utilisation of ~90.83%.

Packages/Applications Installed: No new modules have been installed this month. To view list of available modules.
> module avail

Other Recent Work on HPC

Fabrication, Assembly, and Cooldown of the D-Shaped High Temperature Superconducting Magnet	Mahesh M Ghate
Fluid Simulation: A Comparative Plasma Transport Study on Axisymmetric Cylindrical and Race-track ICP Ion Source Geometries	Dr. Ram Swaroop
Design, Fabrication and Testing of a D-Shaped High Temperature Superconducting Magnet	Mahesh M Ghate
Engineering Design of Finger-type Gas cooled Plasma facing component	Vinay Menon
Leveraging Artificial Intelligence for Occupational Health and Safety	Manika Sharma

Acknowledgement

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Join the HPC Users Community

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If you wish to contribute an article in GAṆANAM, please write to us.

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