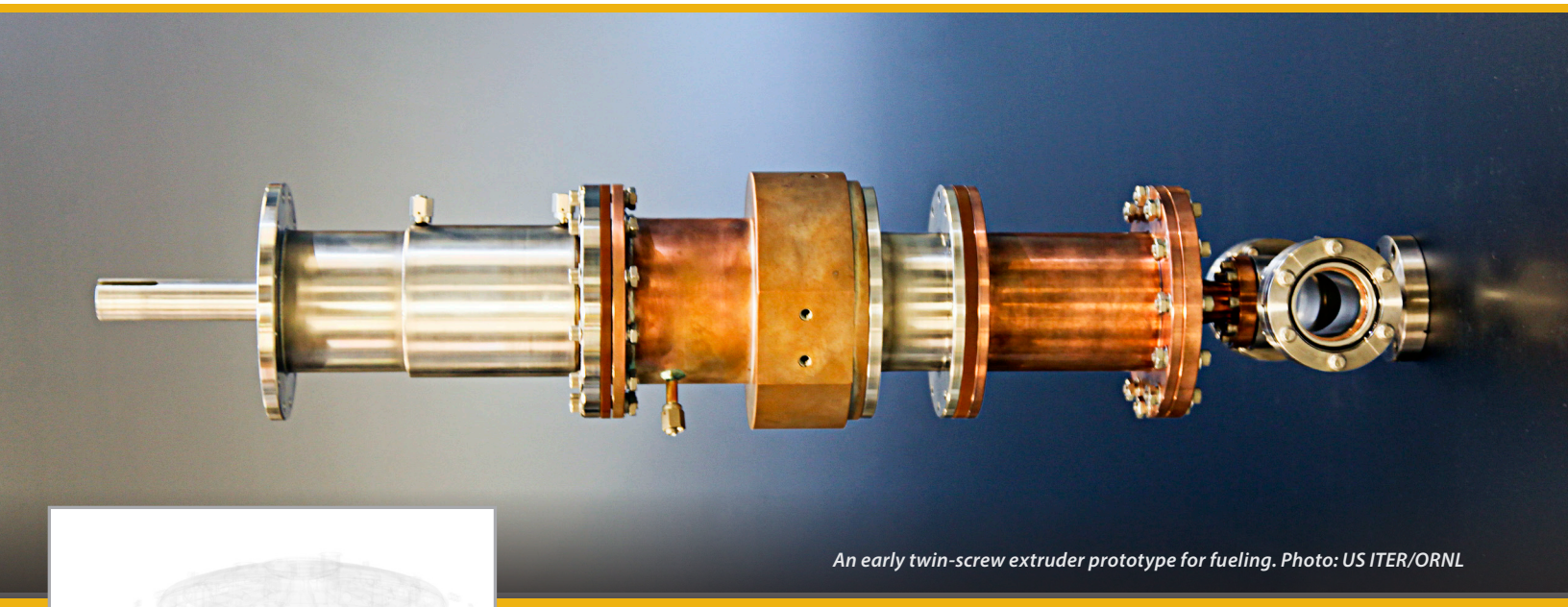
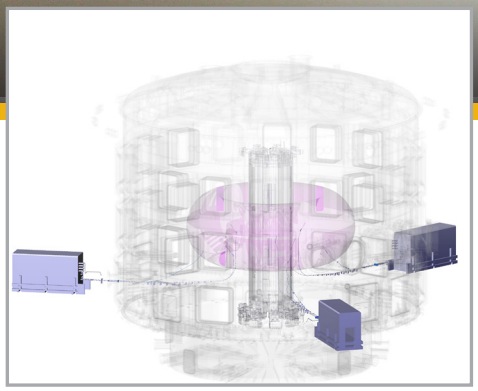
Pellet Injection



An early twin-screw extruder prototype for fueling. Photo: US ITER/ORNL



Pellet injection design. Image: US ITER

A dual-nozzle prototype was developed for fueling and ELM mitigation. Photo: US ITER/ORNL

US Contribution

US ITER is responsible for the research and development, design, and fabrication of the pellet injection system for ITER.

Overview

The pellet injection system has three functions: providing a steady state supply of deuterium and tritium fuel; mitigating the impact of edge localized modes on the plasma-facing components; and providing impurity pellets for physics studies.

ITER will require significant fueling capability to operate at high density for long durations. Pellet injection, from the inner wall location, provides efficient core and edge fueling. The fueling injector will deliver hydrogen, deuterium, or a deuterium/tritium mixture, at up to 16 times per second, as required by plasma operations.

The injector can also provide pellets to the outer edge of the plasma. Delivering small pellets to the plasma edge increases the frequency and reduces the intensity of edge localized mode instabilities, thus mitigating their impact on plasma-facing components.

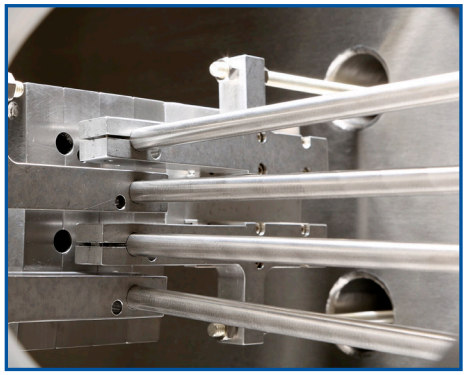
Status

Final design of the flight tubes is complete. Prototypes of the subsystems used to form, accelerate, and guide the fueling and edge-localized-mode mitigation pellets are being tested. Preliminary design of the cask enclosure that houses the pellet injection subsystems has been initiated.

Pellet Injection

Close-up view of the twin-screw extruder. Photo: US ITER/ORNL

Testing is performed at the ORNL pellet lab. Photo: US ITER



Internal view of a pellet guide tube selector test unit. Photo: US ITER/ORNL

Technical Description

Number of injectors: two at start-up, upgradeable to six

Fueling configuration: high field side pellet injection

Edge-localized-mode (ELM) control configuration: low field side and high field side pellet injection

Fueling pellets: deuterium (D), deuterium/tritium (DT) or hydrogen (H)

ELM control pellets: D, DT, or H

Impurity pellets: nitrogen (N_2), argon (Ar) or neon (Ne)

Typical pellet volume for fueling: 50 mm^3 – 92 mm^3

Typical pellet volume for ELM control: 17 mm^3 – 33 mm^3

Typical pellet volume for impurity pellets: 50 mm^3

Maximum number of impurity pellets per pulse: 5

Flow rate for fueling: 111 Pa m^3/s for DT (equivalent to 100 Pa m^3/s of pure tritium) or 120 Pa m^3/s for H and D

Nominal pellet speed: 300 m/s

Nominal pellet frequency for fueling: 4 Hz

Maximum pellet frequency for fueling: 16 Hz

Nominal pellet frequency for ELM control: 45 Hz (upgraded configuration)

Maximum pellet frequency for ELM control: 60 Hz (upgraded configuration)

Maximum injection duration: 3,000 seconds

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