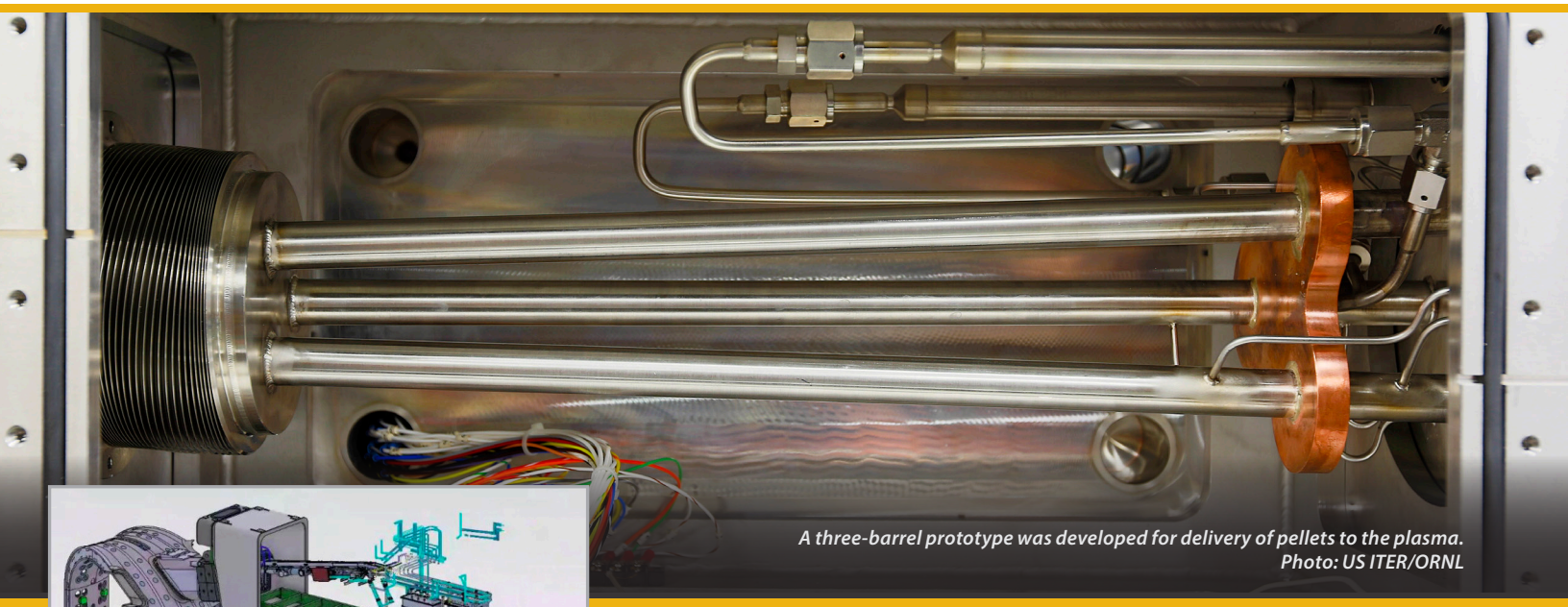
Disruption Mitigation



A three-barrel prototype was developed for delivery of pellets to the plasma. Photo: US ITER/ORNL

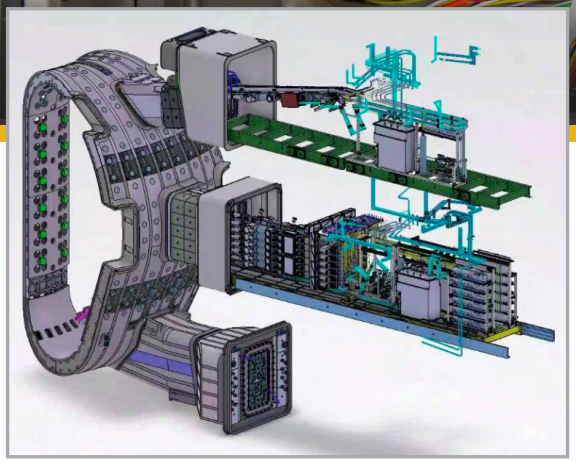


Image of the disruption mitigation system installation, in one ITER vacuum vessel sector. Image: ITER Organization

US Contribution

US ITER is responsible for disruption mitigation technology development and deployment of prototypical shattered pellet injection units on existing tokamaks (up to a capped value).

Overview

The system has three functions: 1) limiting electromagnetic impacts of current decay on components, 2) limiting the magnitude of heat and particle flux to the plasma facing components, and 3) suppressing the formation of, or dissipating (if formed), a runaway electron beam.

Shattered pellet injection involves cryogenically freezing pellets of the desired species (hydrogen, deuterium, or neon) in a specially designed "pipe gun." The pellet is injected into the plasma with a high-pressure gas (hydrogen or deuterium) when a disruption is detected. The pellet is shattered upon entry to better assimilate the material into the plasma.

Status

A shattered pellet injection prototype has been delivered to the Joint European Torus (JET) tokamak in the United Kingdom where it supports the ITER Organization's effort to develop ITER relevant disruption mitigation methods and technology.

Similar prototypes have been deployed for disruption mitigation experiments on the DIII-D tokamak in the United States and the Korea Superconducting Tokamak Advanced Research (KSTAR) tokamak in Daejeon, South Korea.

Pellet fragments exiting the shatter tube of the SPI testbed. Photo: ORNL

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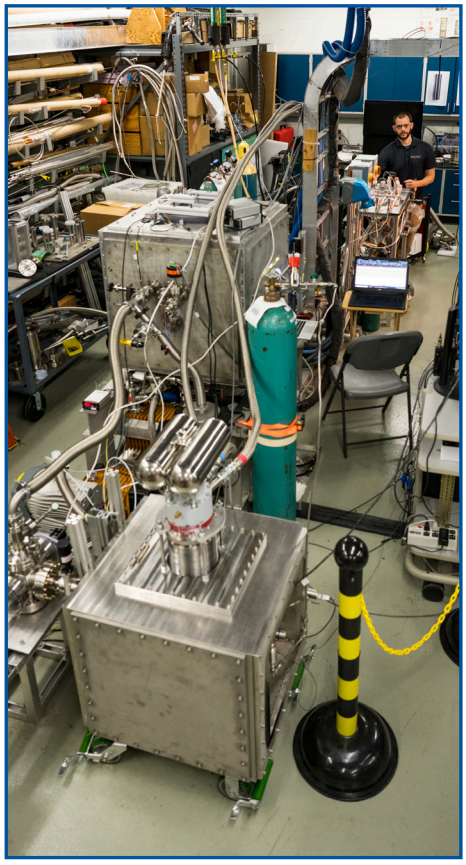
Plastic model of a pellet illustrating the size that will be used in ITER's disruption mitigation system. Photo: ORNL



The SPI testbed for disruption mitigation technology development. Photo: ORNL

Technical Description

Material delivery for thermal mitigation event:
8-10 kPa*m^3 gas equivalent (nominally 2 kPa*m^3 per injector location)

Material delivery for runaway electron mitigation event:
up to 90 kPa*m^3 gas-equivalent of material

Pellet types:
hydrogen, deuterium, and neon

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