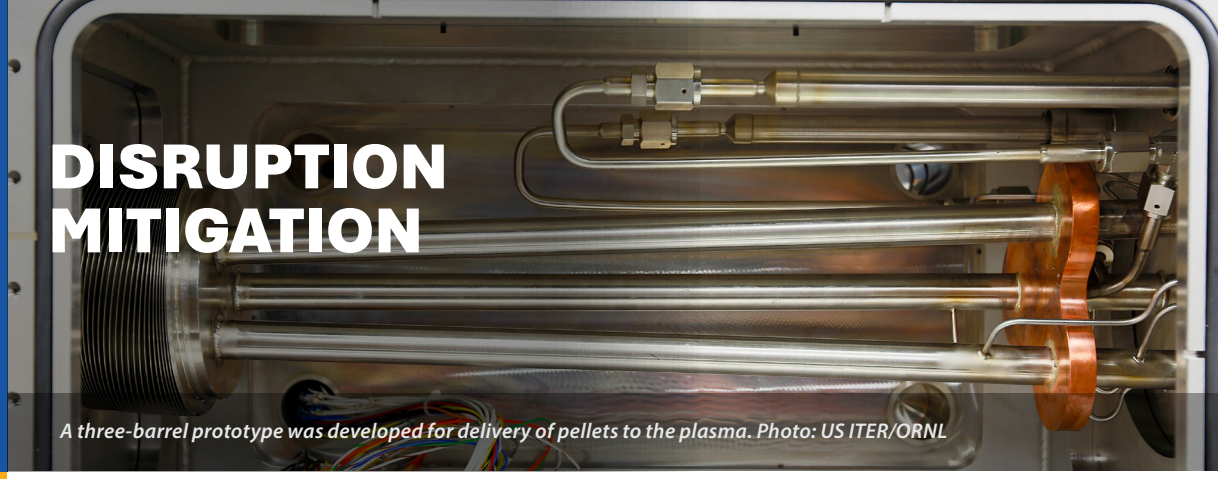
DISRUPTION MITIGATION



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

U.S. CONTRIBUTION

The United States is developing the technology for shattered pellet injection, the key element of ITER's disruption mitigation system. The system's purpose is to protect plasma-facing components from heat and other forces that arise during a plasma current disruption event.

OVERVIEW

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

Shattered pellet injection involves cryogenically freezing pellets of the desired species (hydrogen or hydrogen mixed with neon) in a specially designed "pipe gun." When a disruption precursor event is detected, a large frozen pellet is injected at high velocity into the plasma with a high-pressure hydrogen gas). The pellet is shattered upon entry, resulting in a spray of frozen shards that efficiently cool the plasma and mitigate the impacts of the disruption.

STATUS

US ITER is utilizing a laboratory test stand for hardware development and deploying prototypical shattered pellet injection units on existing tokamaks around the world. Analysis is ongoing of experiments at the Joint European Torus (JET) in the United Kingdom using one of the shattered pellet injection prototypes in support of developing 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.

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

Pellet fragments exiting the shatter tube of the test bed. Photo: ORNL

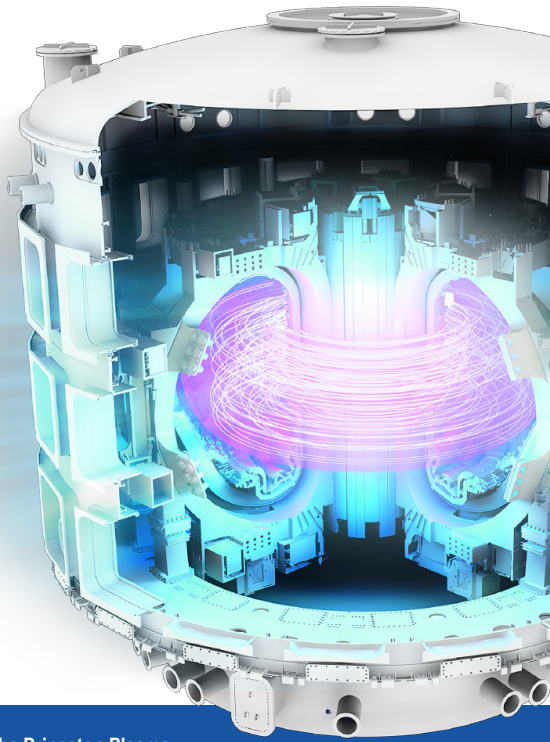
The SPI test bed for disruption mitigation technology development. Photo: ORNL

TECHNICAL DESCRIPTION

Material delivery for thermal mitigation event: 8-10 kPa*m³ gas equivalent (nominally 2 kPa*m³ per injector location)

Material delivery for runaway electron mitigation event: up to 90 kPa*m³ gas-equivalent of material

Pellet types: Hydrogen and hydrogen mixed with neon



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