



National Institutes for  
Quantum Science and Technology  
Naka Institute for Fusion Science and Technology



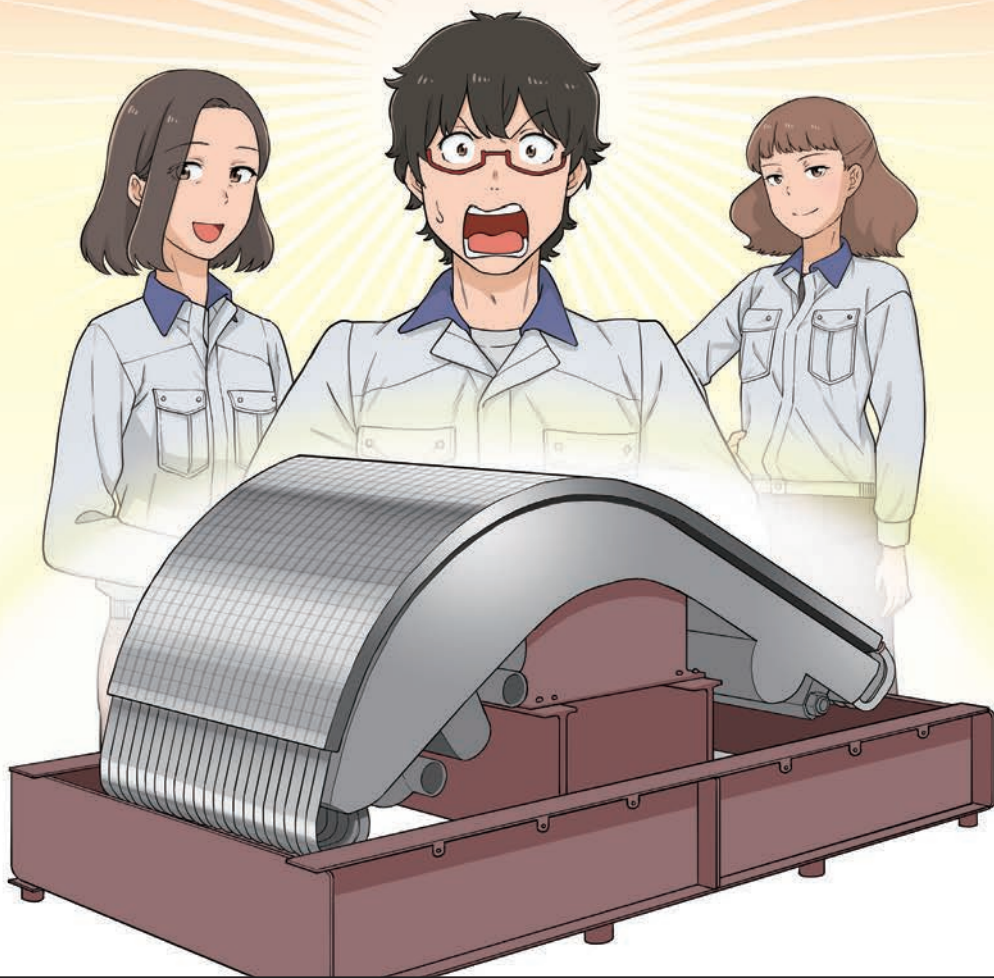
ITER Japan Domestic Agency

# A small Sun on Earth

# ITER

イーター

Vol.6 ~ The Spirit of Monozukuri: Divertor ~



# CHARACTERS



## TAIYO TENNO

New recruit at QST (National Institutes for Quantum Science and Technology), the Japanese Domestic Agency of the ITER project. He is on a whirlwind tour of the ITER-related facilities at QST's Naka Fusion Institute.



## MIRAI MITSUHASHI

Veteran QST staff member. She is in charge of leading the tour of QST facilities for new hires.



### MAKO KAWAI

Researcher at QST, responsible for the development of the components for ITER's divertor.



### Group leader ŌHATA

Researcher at QST and a kind-hearted boss.



### Company M

In charge of manufacturing the divertor.



### Company Y

Specializing in metal alloys and tasked with manufacturing the copper piping.



### Company A

Tasked with preparing the tungsten materials.



### Company N

Tasked with the tungsten bonding process.

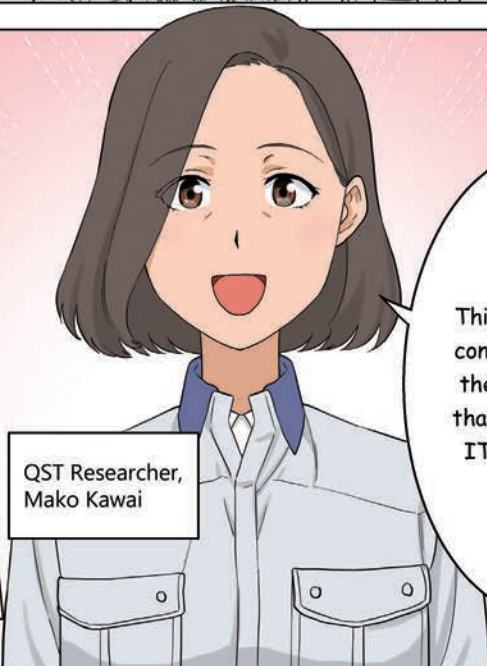
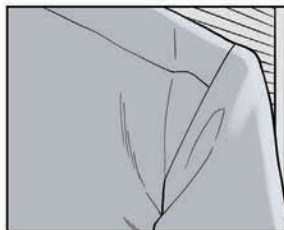
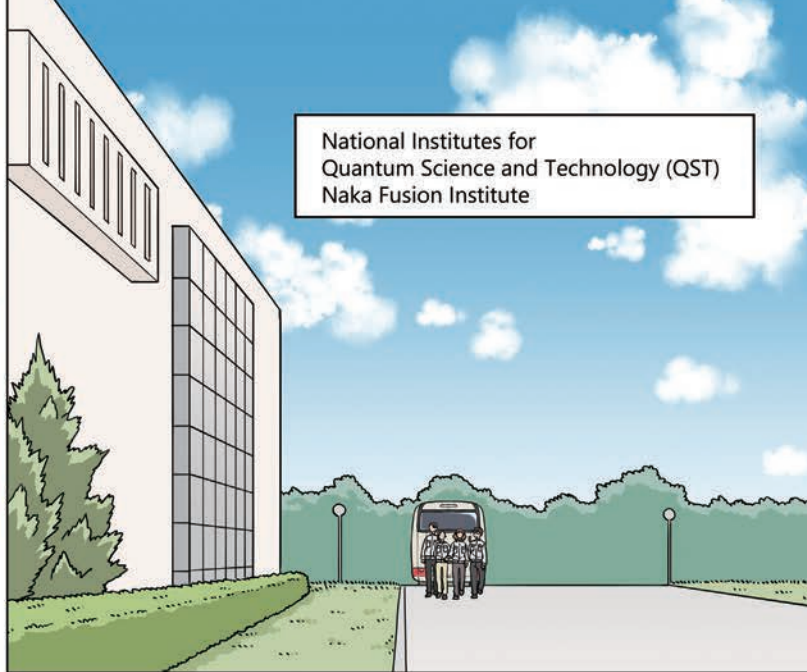
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## Our story so far...

Our protagonist, Taiyo, who met Soléane when he was a student and ever since became fascinated with ITER, has graduated from university and is now an administrative staff member at QST. He is taking part in a tour of QST's Naka Fusion Institute as part of his training for new hires, led by QST veteran staff member, Mirai. In the previous issue, we learned about the "gyrotrons," one of the systems used to heat the plasma in ITER. In this issue, we will visit the R&D facility for the "divertor," a system that is essential for maintaining the plasma in ITER.

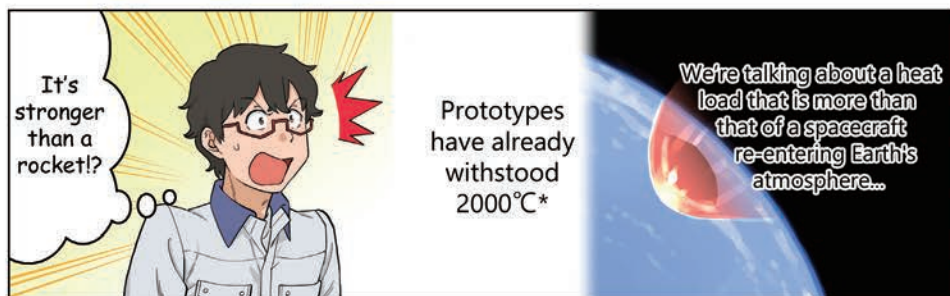
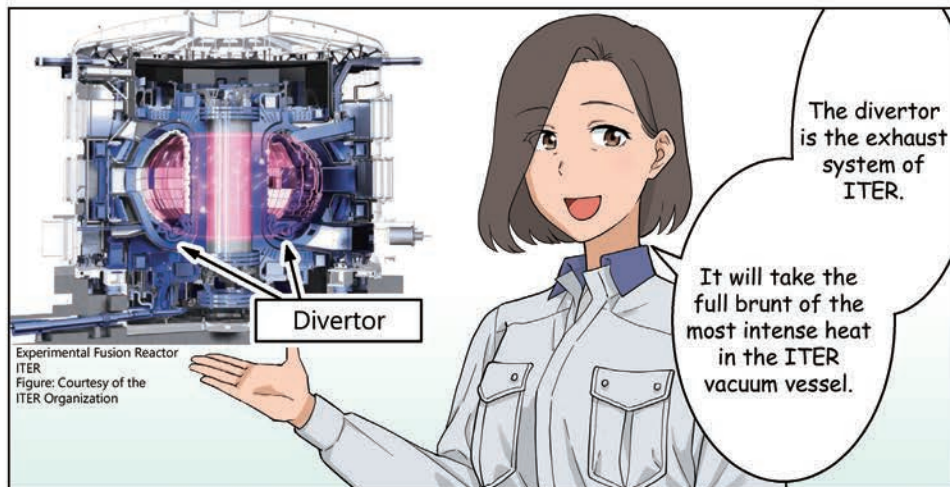


National Institutes for  
Quantum Science and Technology (QST)  
Naka Fusion Institute

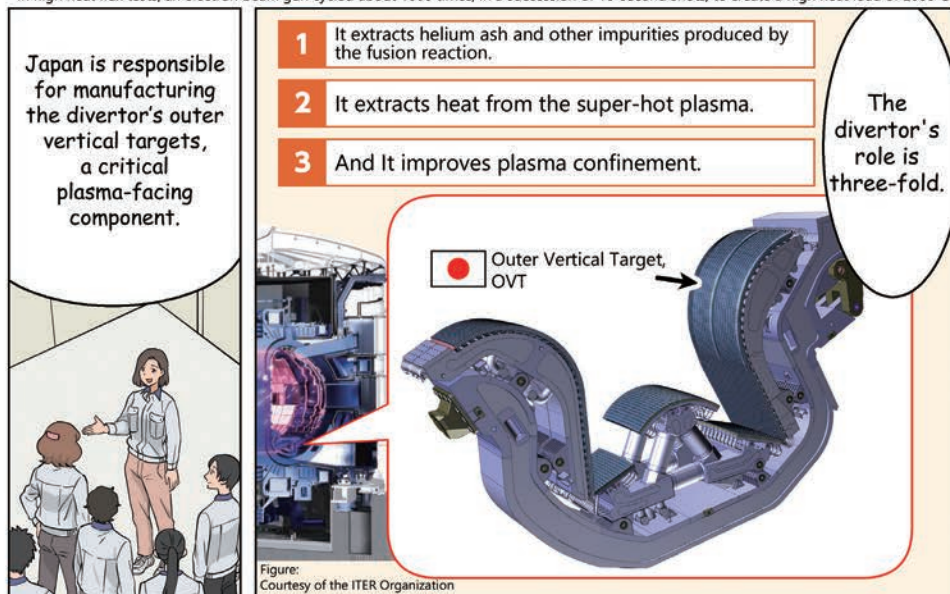


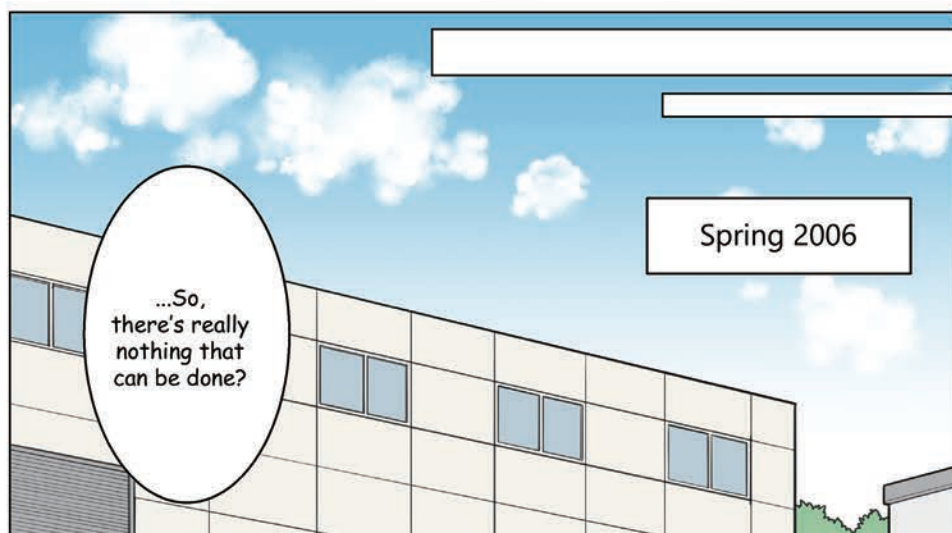
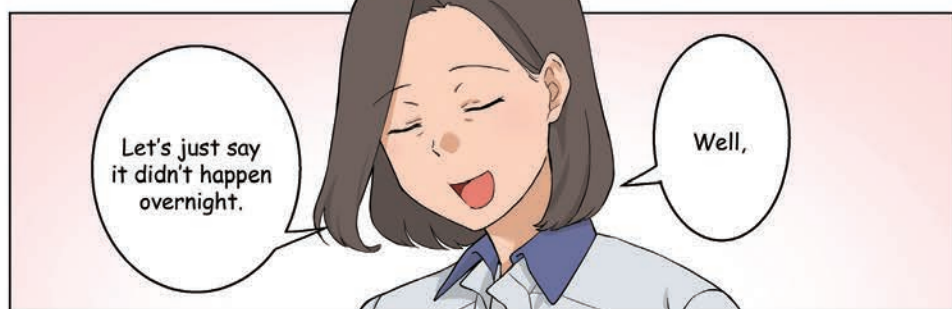
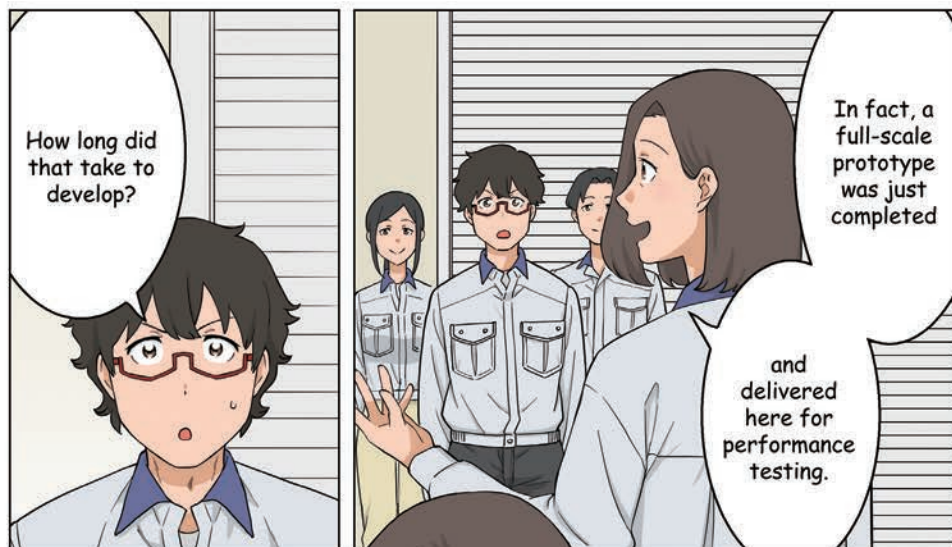
This is where we  
conduct R&D for  
the components  
that make up the  
ITER divertor.

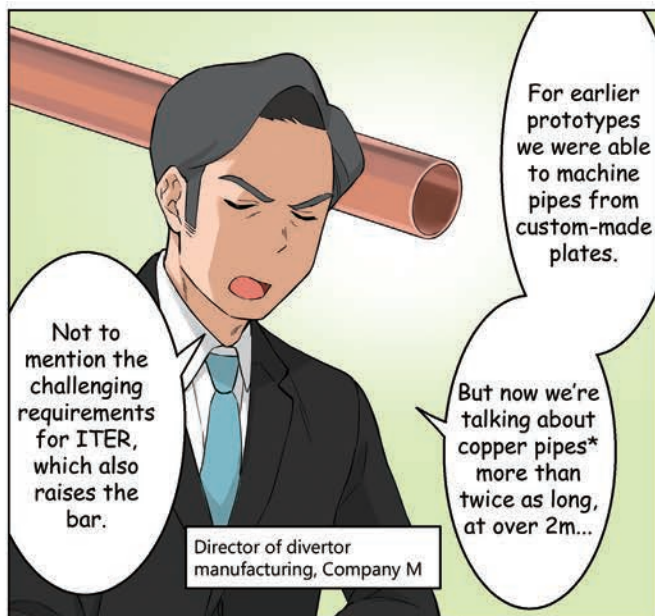




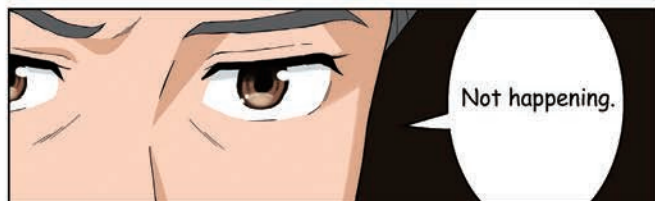
\*In high heat flux tests, an electron beam gun cycled about 1000 times, in a succession of 10-second shots, to create a high heat load of 2000°C



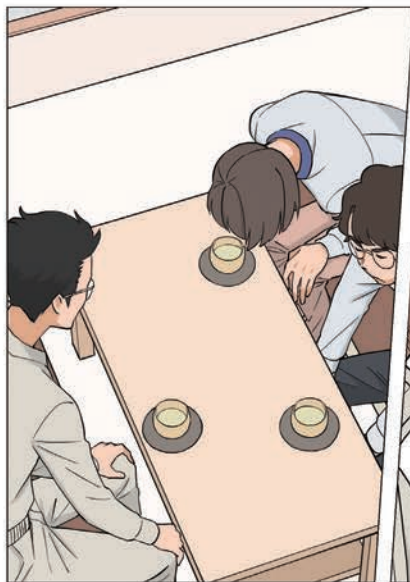


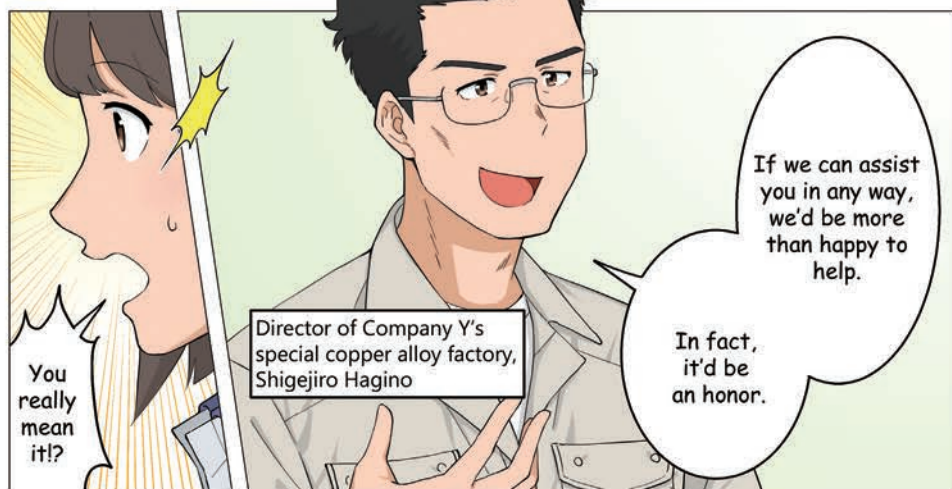
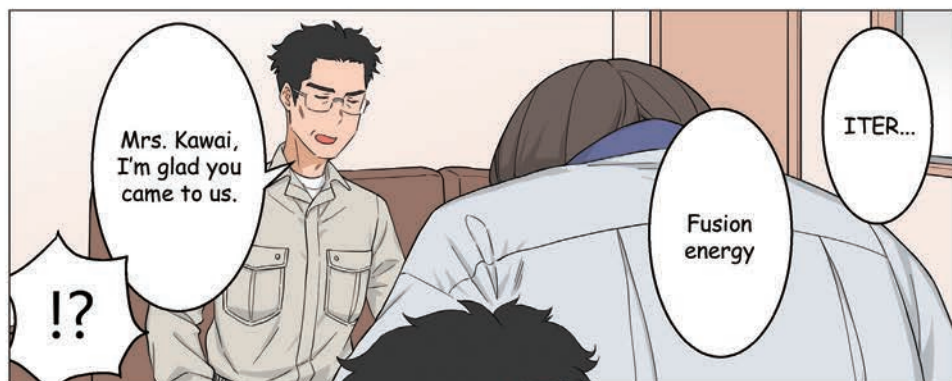


\*ITER-grade, chrome-zirconium-copper alloy cooling pipes

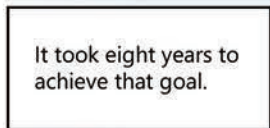
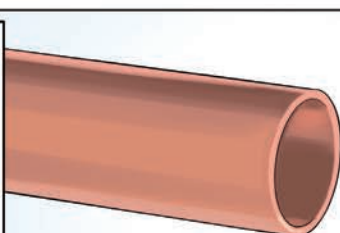
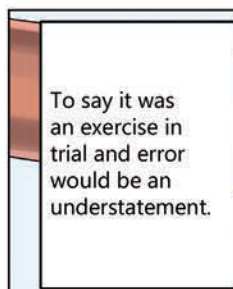
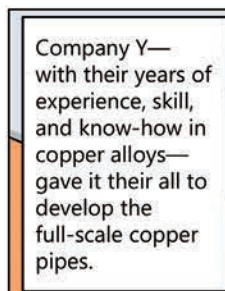
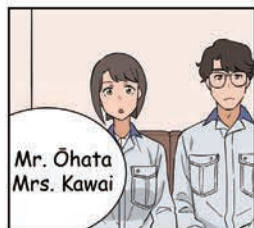












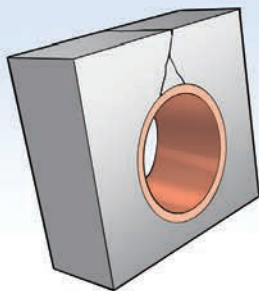
2011

WHAT!?

and if we can't demonstrate that in three years, it'll have broader implications for the ITER project as a whole.

This change also calls for about twice the heat resistance and cooling performance as before,

Redesigning the divertor... at this stage?



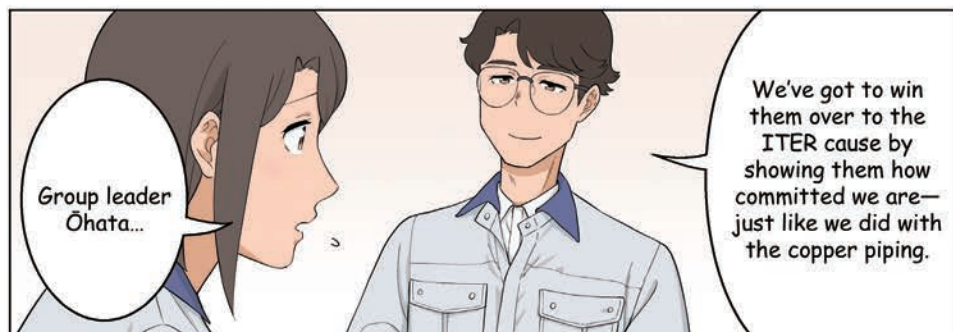
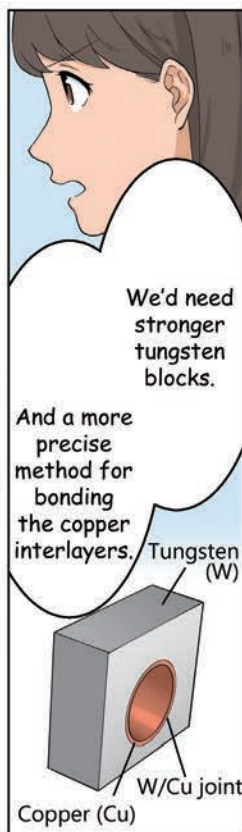
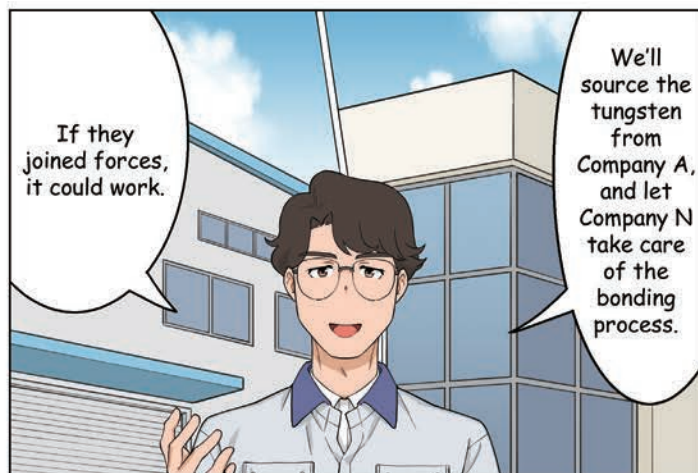
Tungsten test specimens are known to crack...

That can't be... Over 40 years of international R&D effort, and what has been shown time and time again.

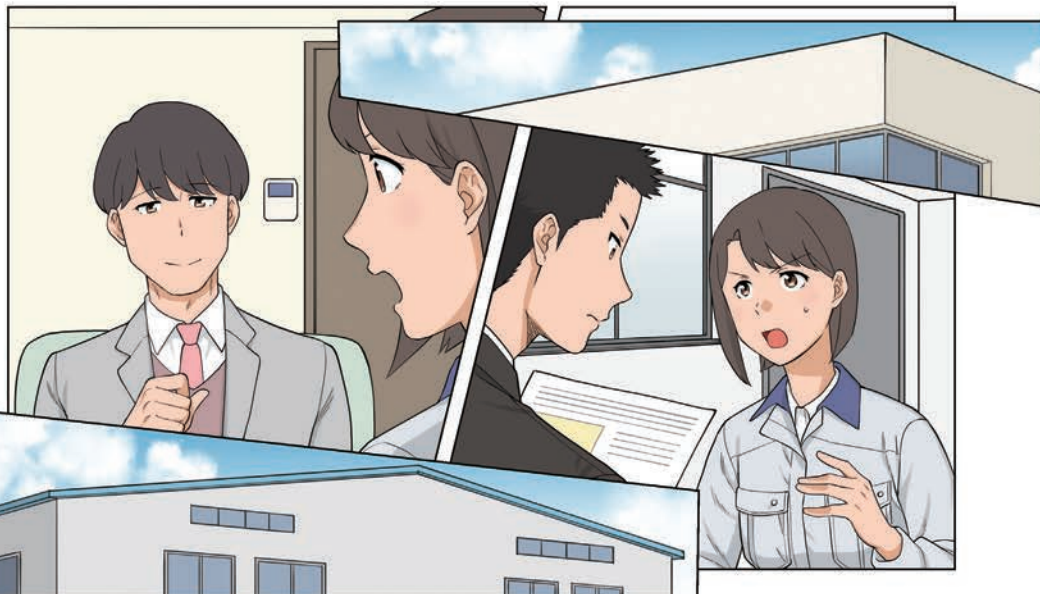
Yep... Changing the plasma-facing material from carbon fiber composite to full tungsten.

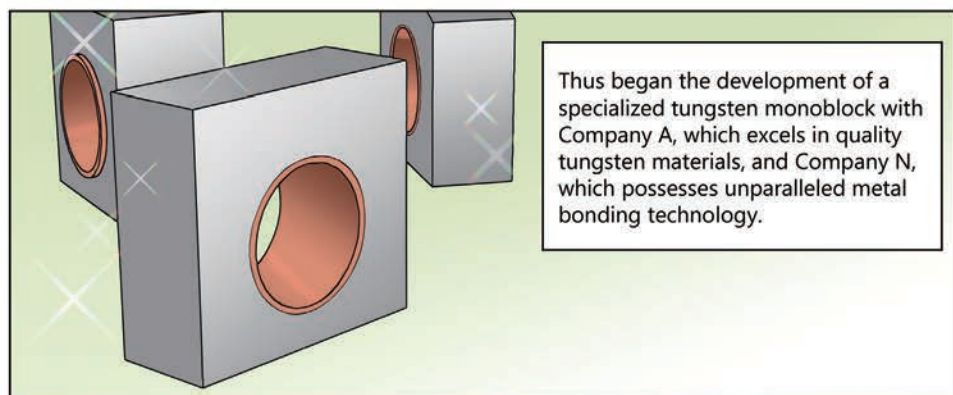
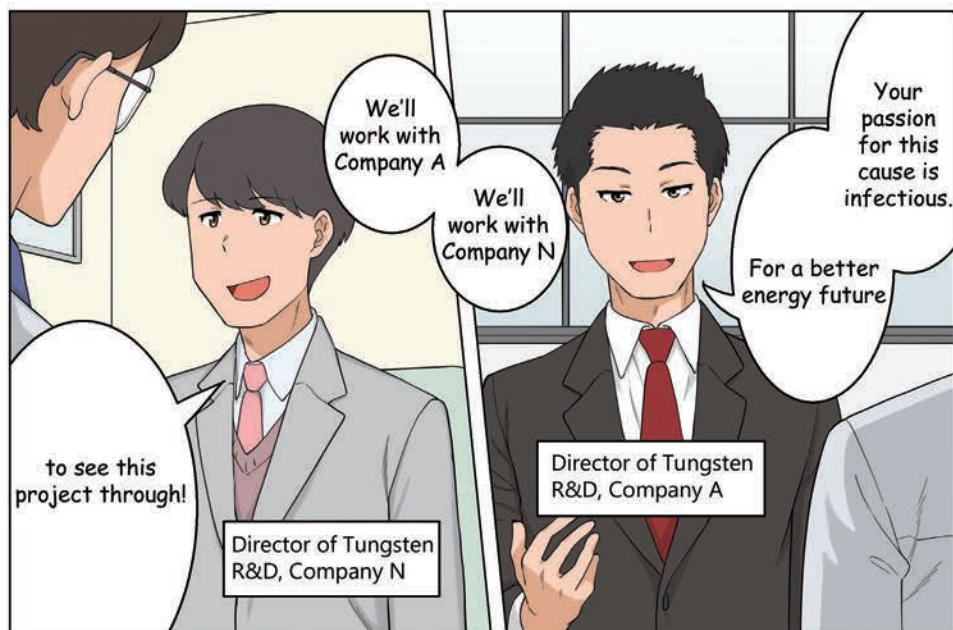
And we only have three years...

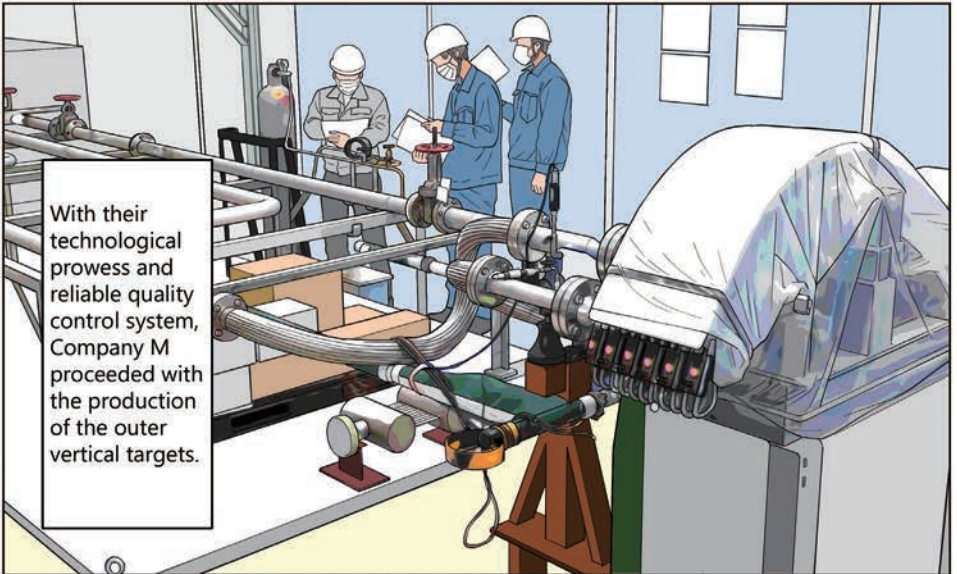
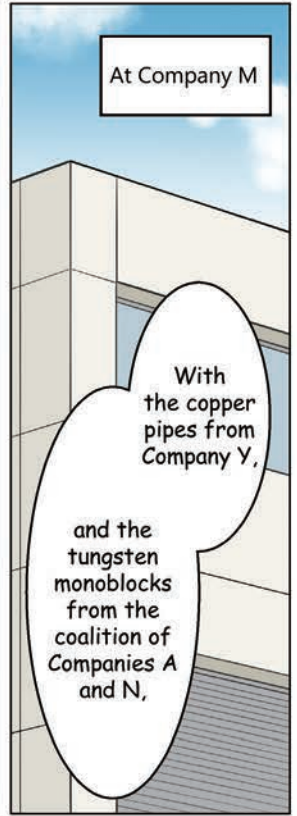
and the interlayer joints separated, making it impossible to conduct heat away.



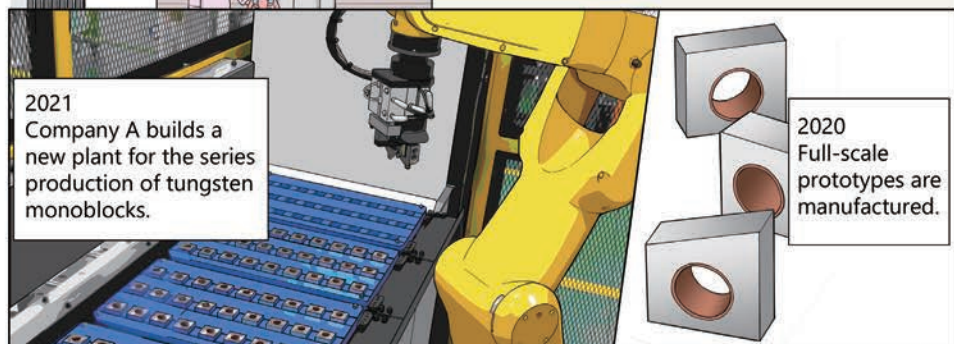
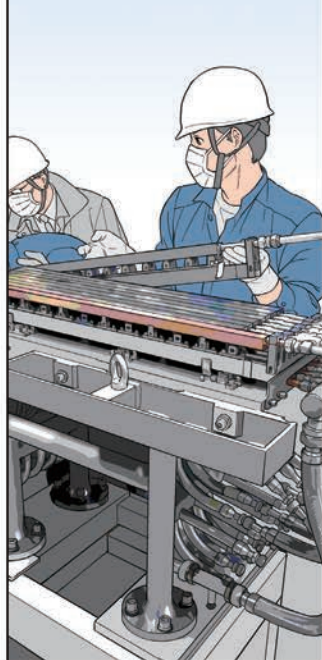


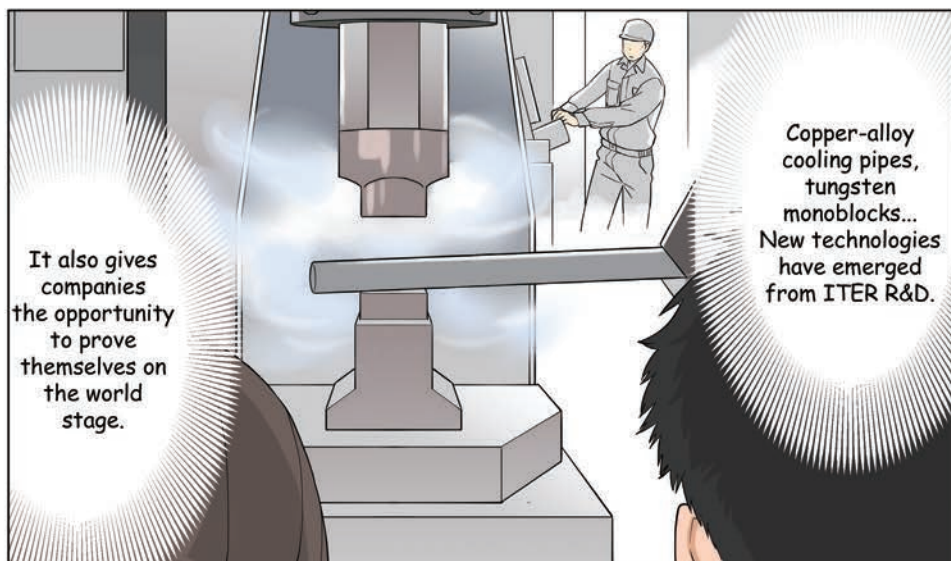
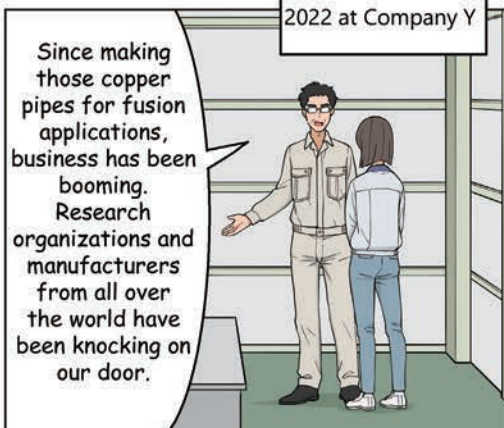
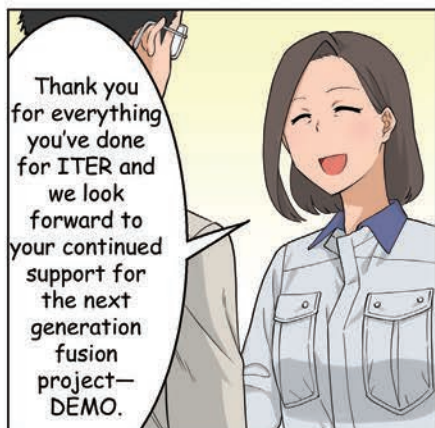




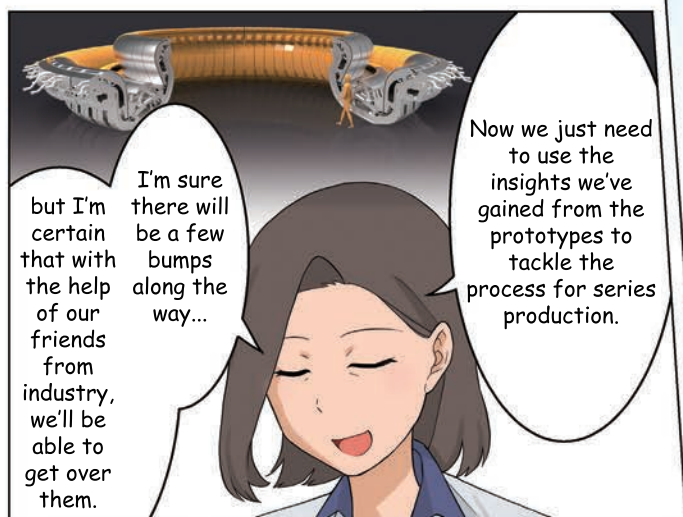
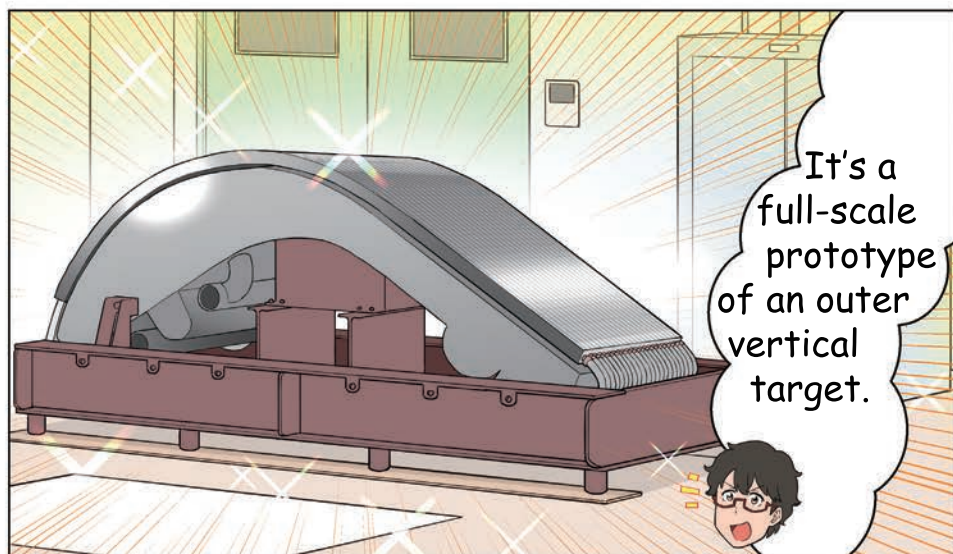
















ITER is the most complex science project in human history.

Even in the face of adversity, so many companies have stood by our side and risen up to the challenge.

Behind every step of "the way" is the spirit of monozukuri, with people whose dedication is unrivaled and technologies that are truly one of a kind.

**To be continued**

This story is fiction based on real events.

# ITER component procured from Japan: Divertor (certain parts)



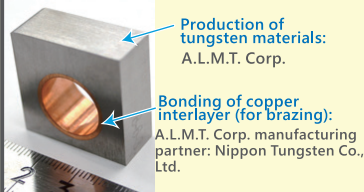
Members of the Plasma Facing Component Technology Group with an outer vertical target prototype

QST has been developing full-scale prototypes and the process for the series production of the outer vertical targets for ITER's divertor. In April 2023, the manufacture of a full-scale prototype, which began in June 2020 with Mitsubishi Heavy Industries, Ltd., was completed and delivered for final acceptance testing at QST's Naka Fusion Institute. (right: high-temperature helium leak tests)

Please visit our ITER Japan News website for more information.  
"ITER Divertor Outer Vertical Target (OVT) Prototype in Final Acceptance Tests"

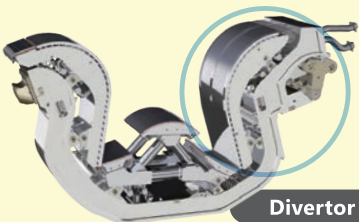
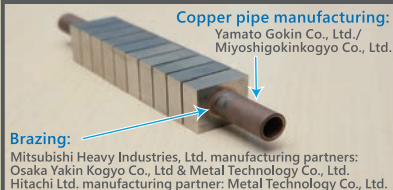


## Tungsten monoblocks

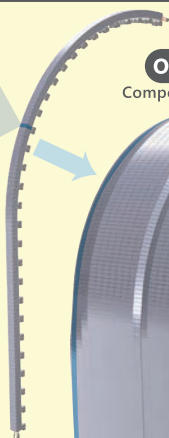


## Copper pipes

ITER-grade, chrome-zirconium-copper alloy cooling pipes

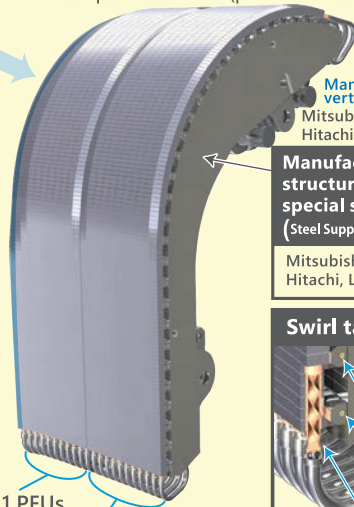


## Plasma-Facing Unit, PFU



## Outer Vertical Target, OVT

Composed of 22 PFUs (per divertor cassette)



Left OVT, 11 PFUs

Right OVT, 11 PFUs

Design and manufacture of ITER components procured from Japan  
"Introduction of partner companies"



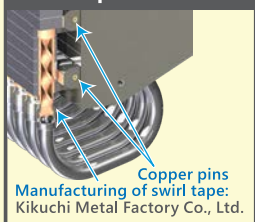
## Manufacturing of outer vertical targets:

Mitsubishi Heavy Industries, Ltd.  
Hitachi, Ltd.

**Manufacture of box-shaped structural supports made of special stainless steel, XM-19 (Steel Support Structure, SSS)**

Mitsubishi Heavy Industries, Ltd.  
Hitachi, Ltd.

## Swirl tape







ITER Site (September 2023)

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# A small Sun on Earth ITER ~ Vol.6 ~

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