

# A small Sun on Earth

# ITER

イーター

Vol.3

~ The Spirit of Monozukuri and the Way to ITER ~



# CHARACTERS

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## TAIYO TENNO

An art major in the thick of job hunting. He became drawn to ITER after his chance encounter with Soléane in France. He previously completed an internship at ITER in Volume 2.

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## SOLÉANE

A French researcher working at ITER in Saint-Paul-les-Durance. Currently lives in Aix-en-Provence. She was the one who initially got Taiyo interested in ITER.

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## HAYATO NAKA

Employee of the Japanese domestic agency for the ITER Project, QST (National Institutes for Quantum and Radiological Science and Technology).

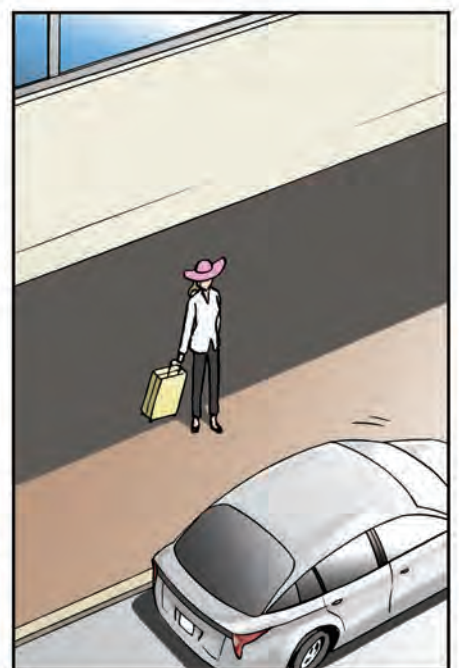
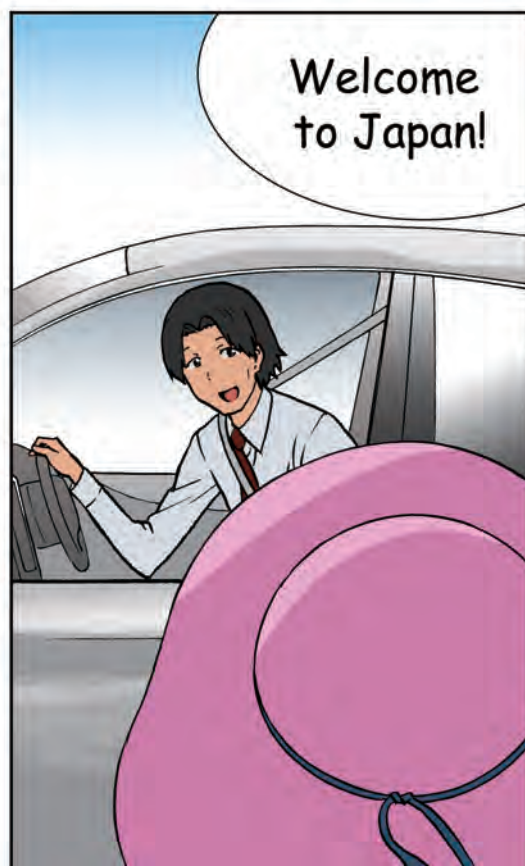
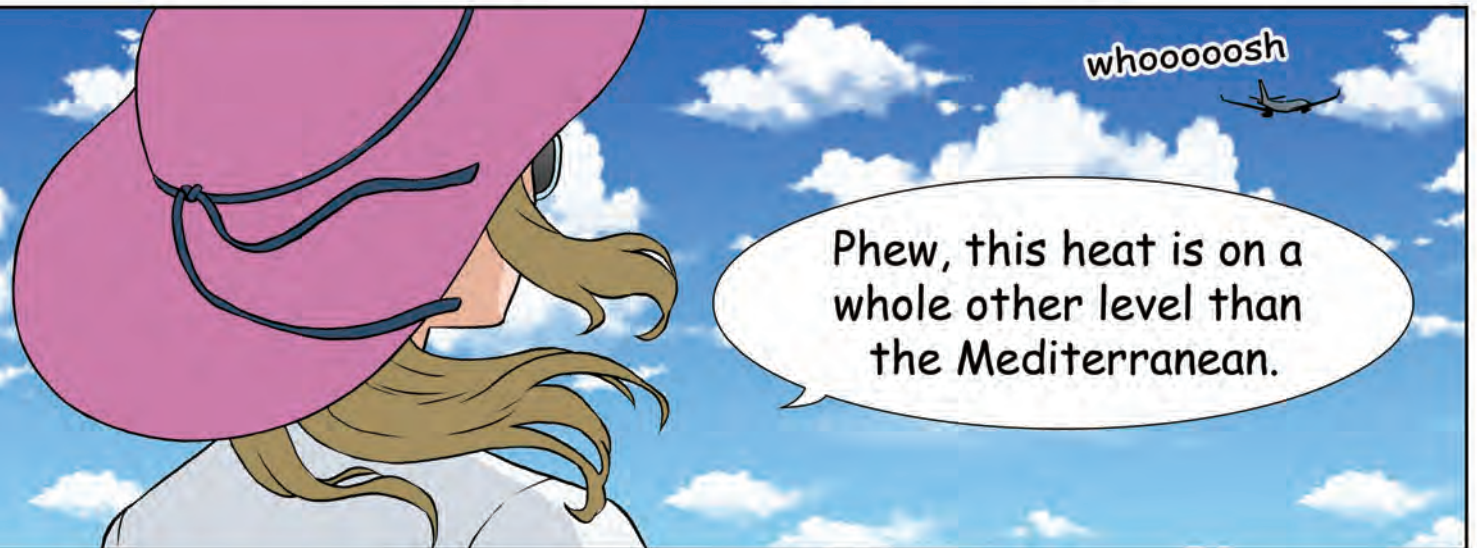
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## KOSEI HIGASHIDE

The head engineer for the toroidal field (TF) coils, which generate the magnetic field required to confine plasma in order to produce nuclear fusion. He takes great pride in his work.

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Thanks,  
Naka-san♪

Soléane



vroom

Mind if we  
take a little  
detour first?



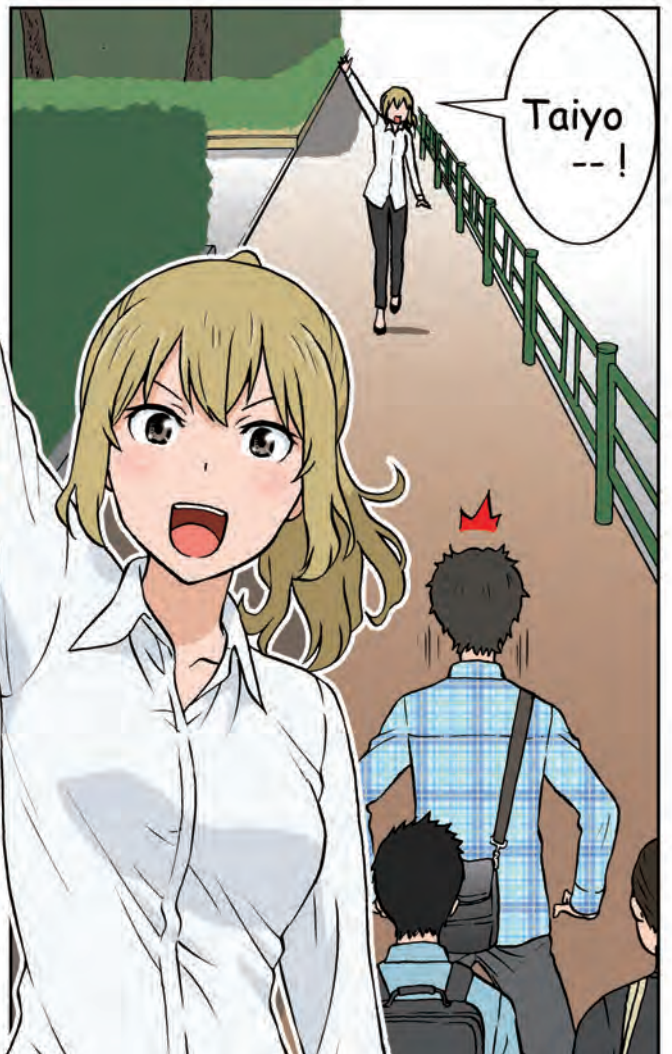
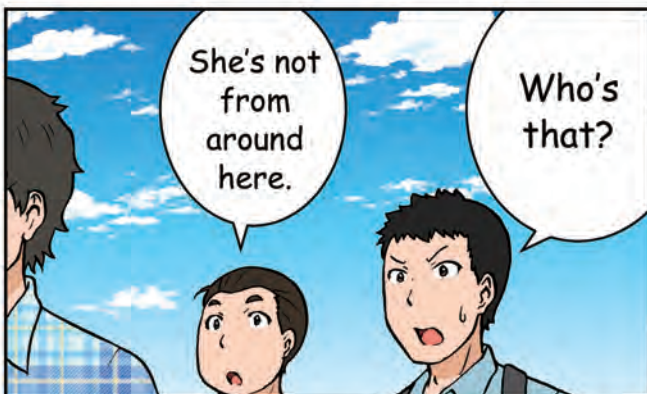
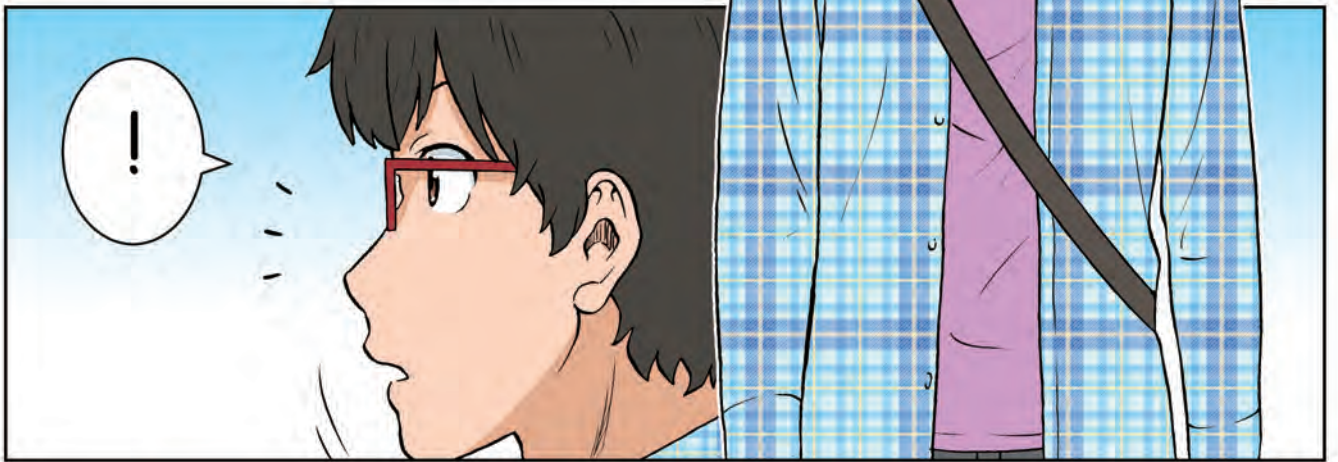
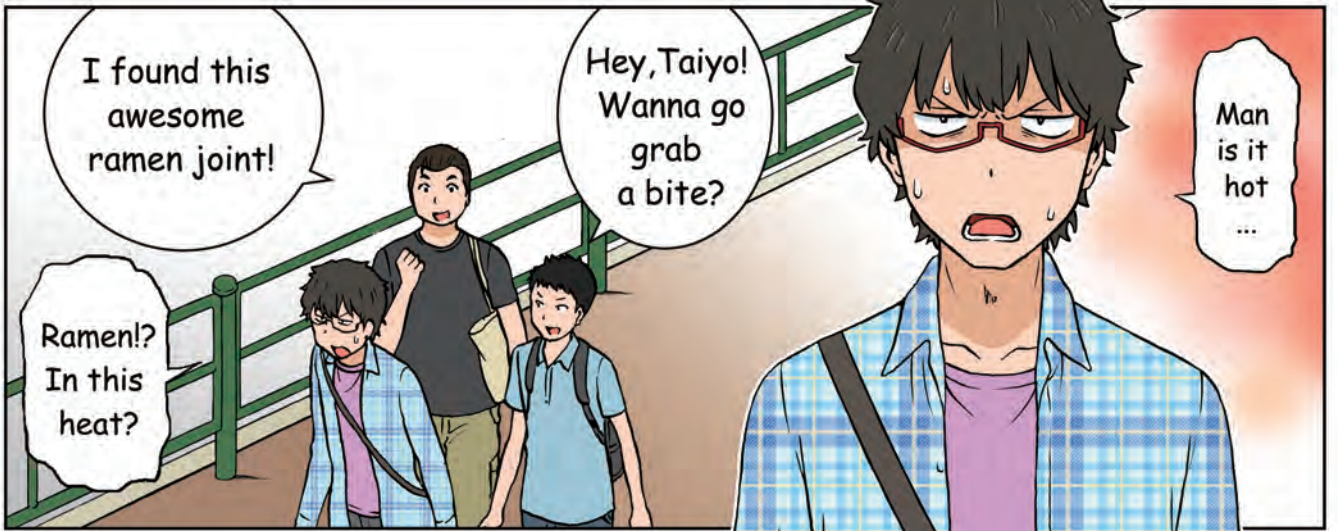
You're  
the  
best.

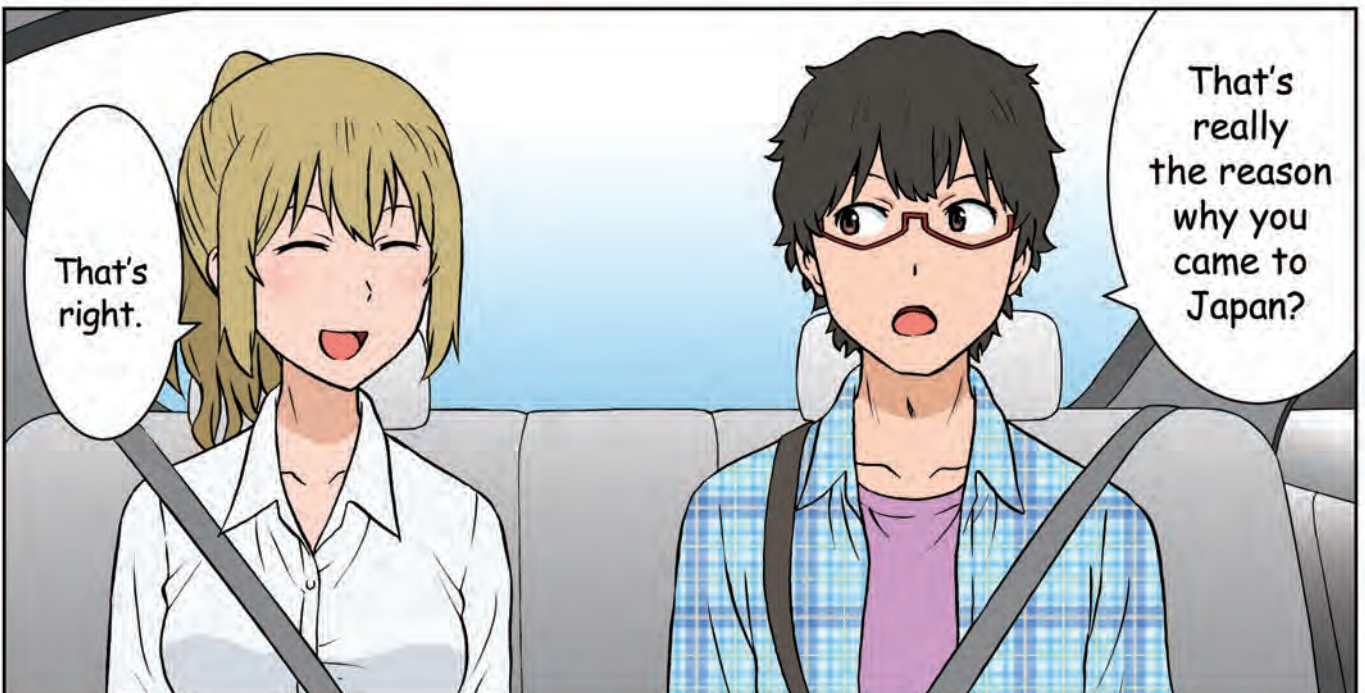
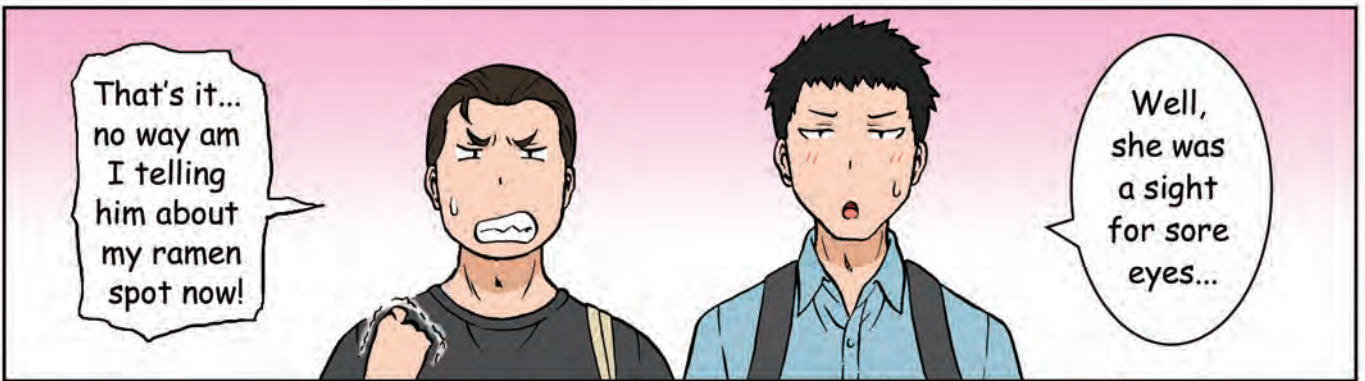
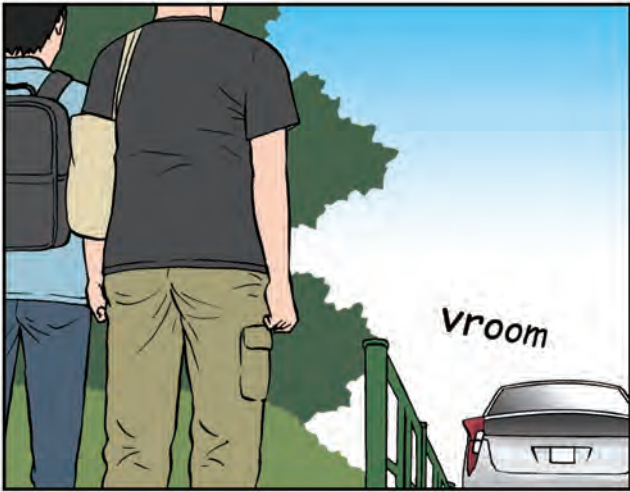


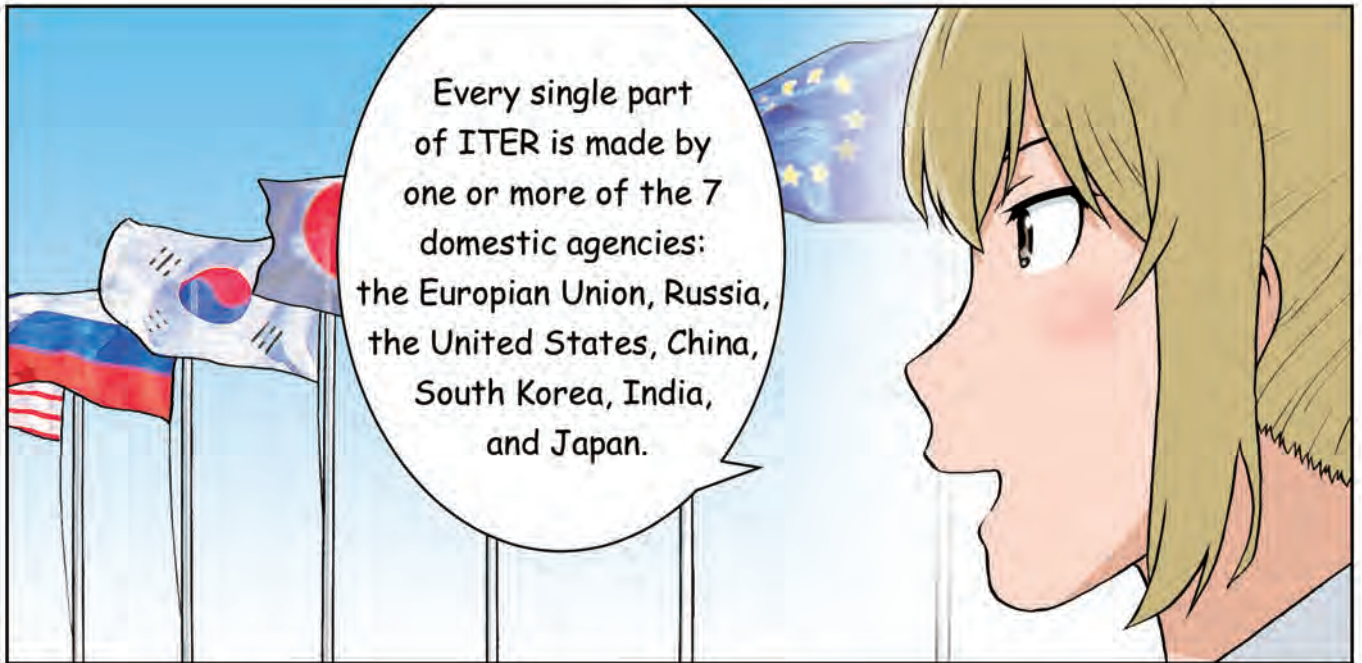
For you,  
sure thing.

Gotta go  
see about  
that guy,  
huh?

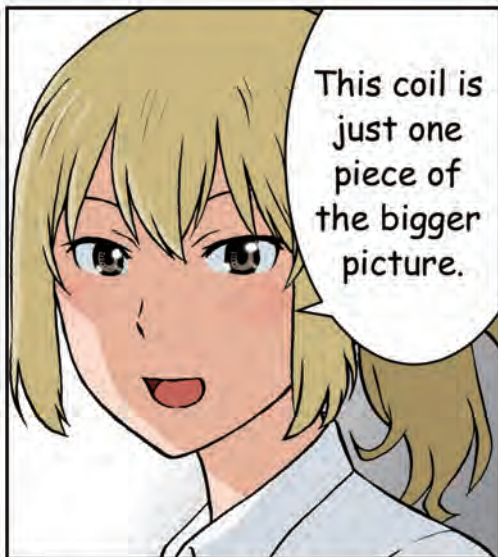
QST employee (National Institutes for Quantum and Radiological Science and Technology)



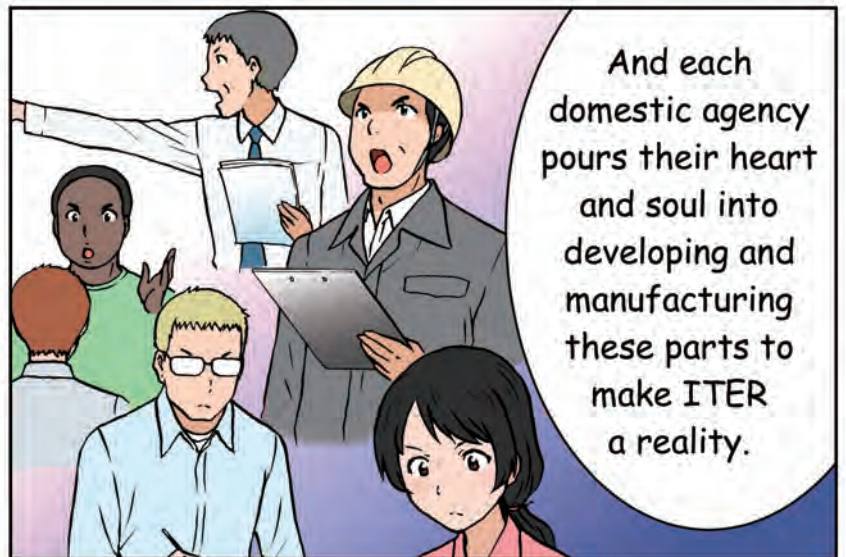




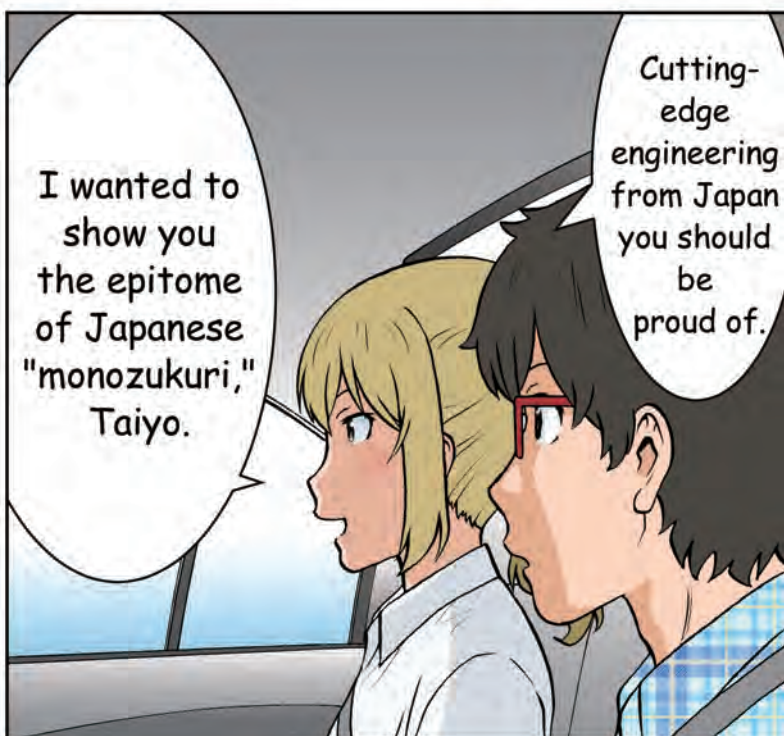
Every single part of ITER is made by one or more of the 7 domestic agencies: the European Union, Russia, the United States, China, South Korea, India, and Japan.



This coil is just one piece of the bigger picture.



And each domestic agency pours their heart and soul into developing and manufacturing these parts to make ITER a reality.



I wanted to show you the epitome of Japanese "monozukuri," Taiyo.

Cutting-edge engineering from Japan you should be proud of.



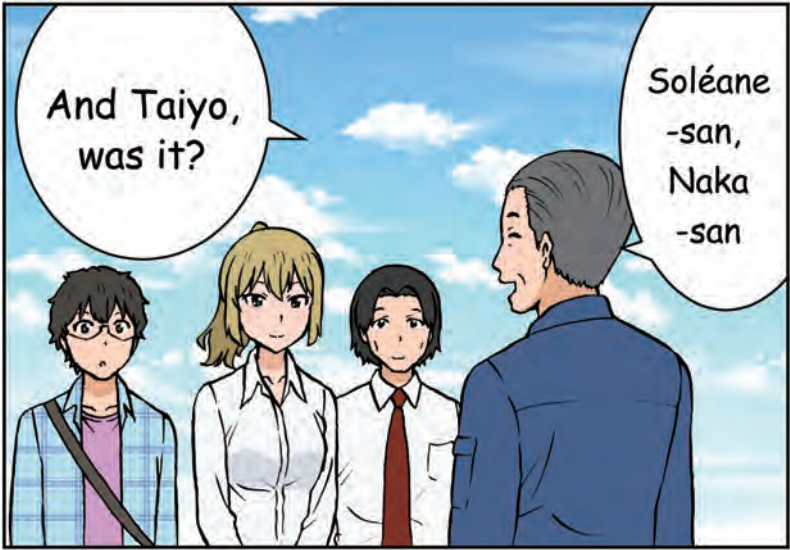
A coil?



of monozukuri ...

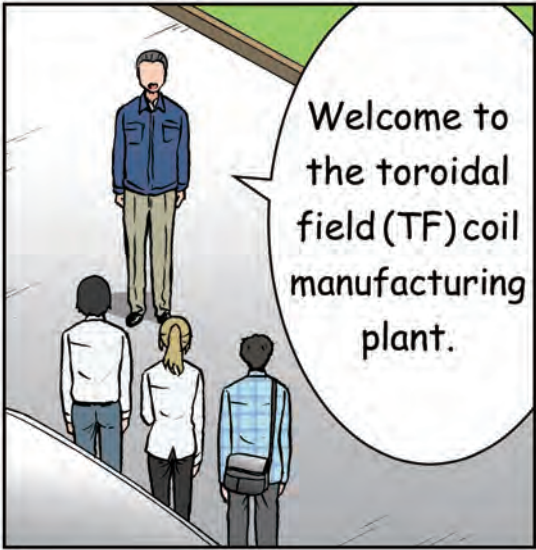


The epitome...

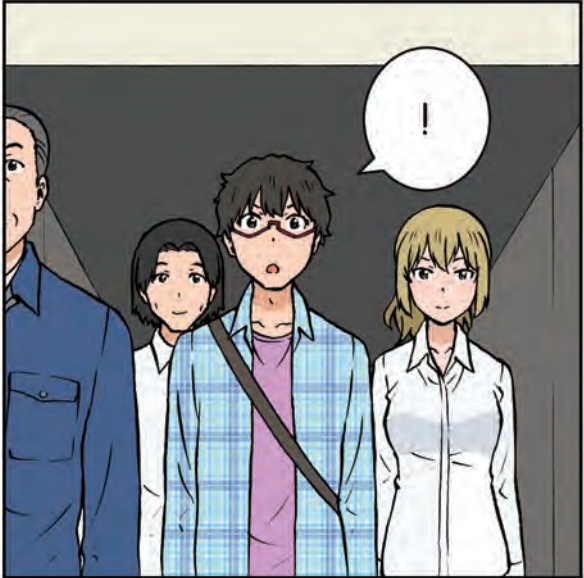


And Taiyo, was it?

Soléane -san, Naka -san



Welcome to the toroidal field (TF) coil manufacturing plant.

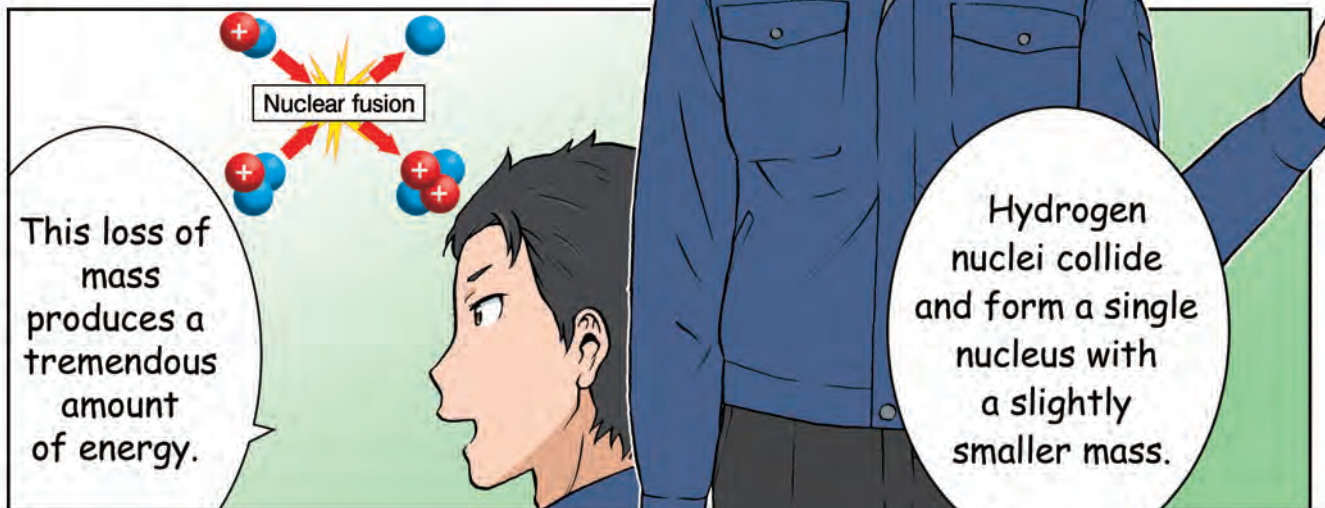
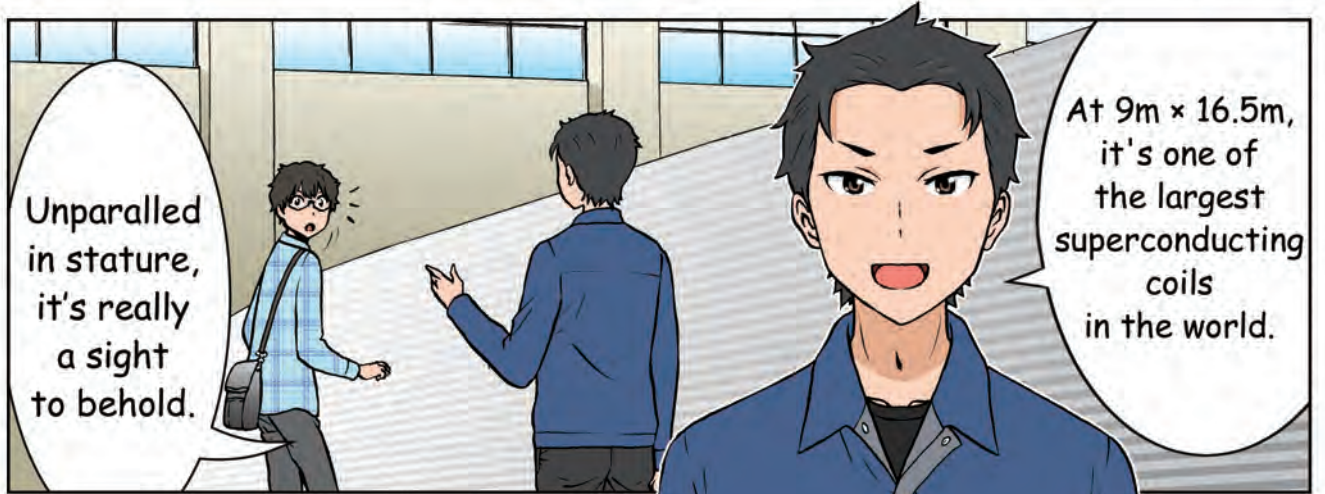
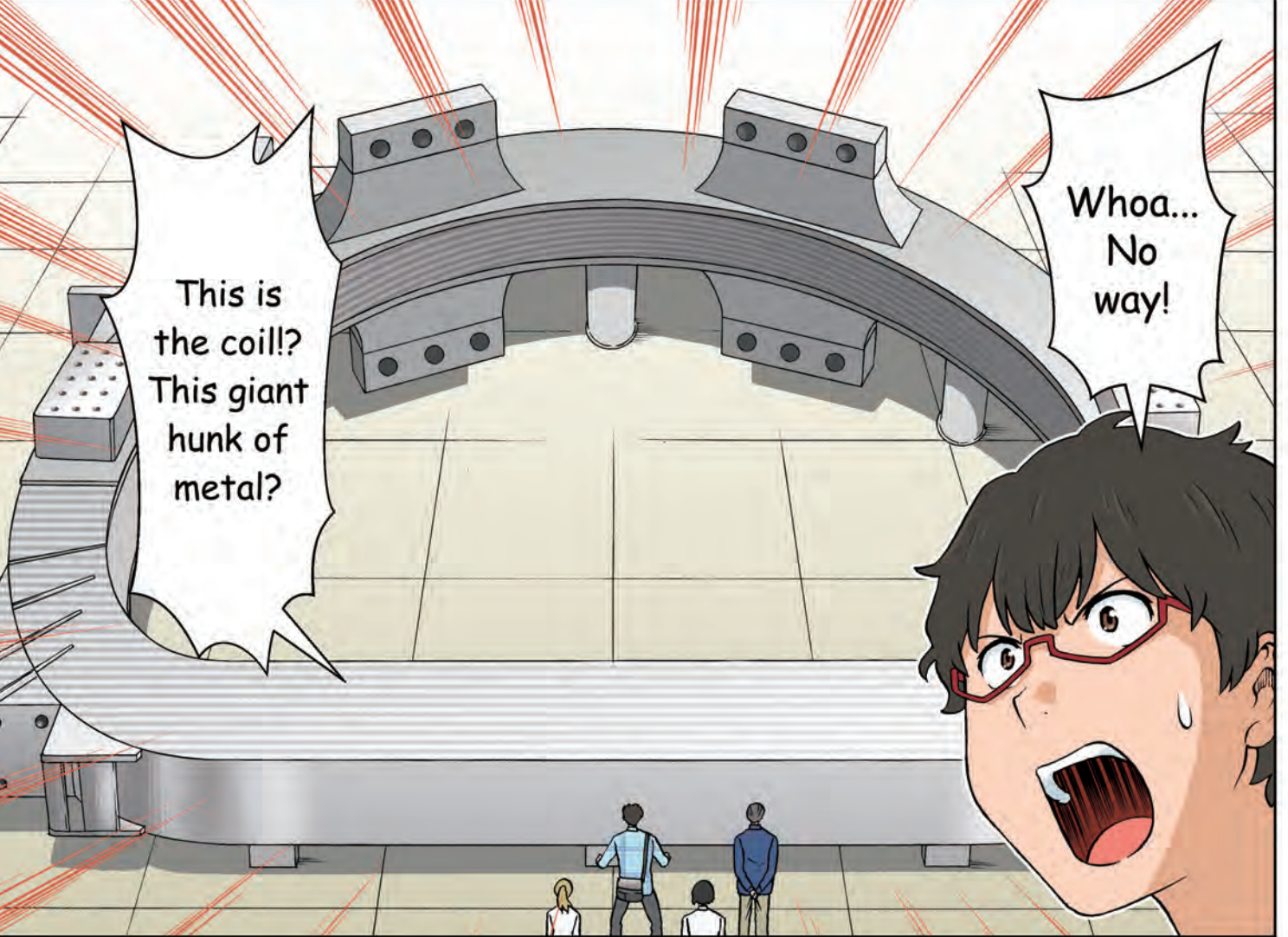


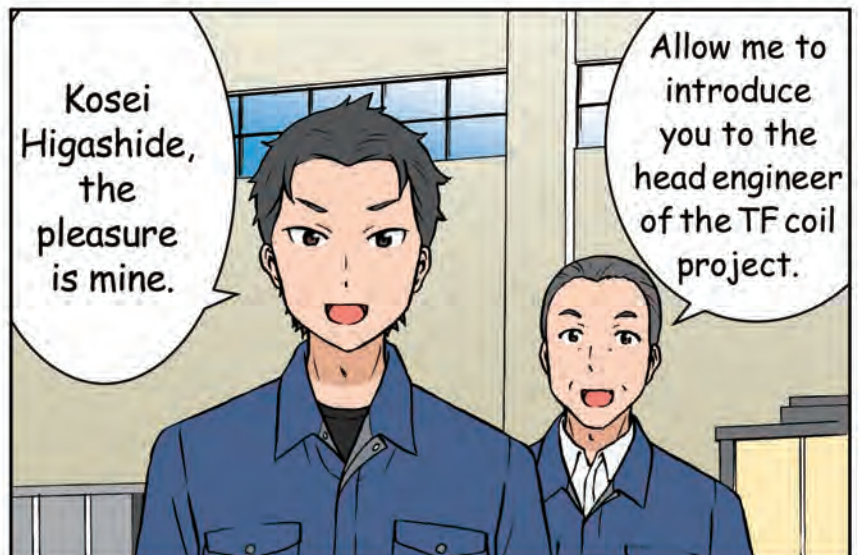
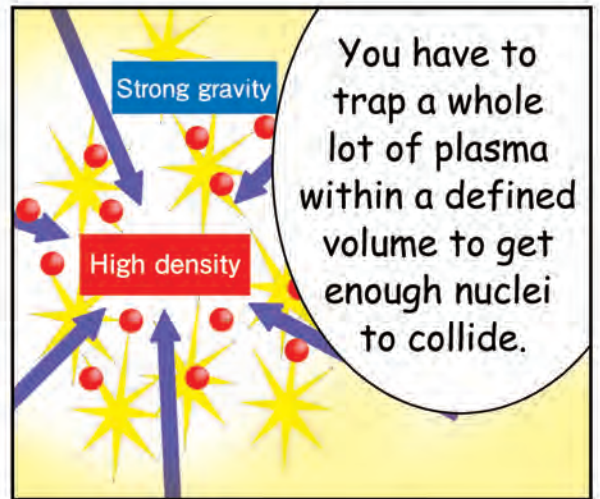
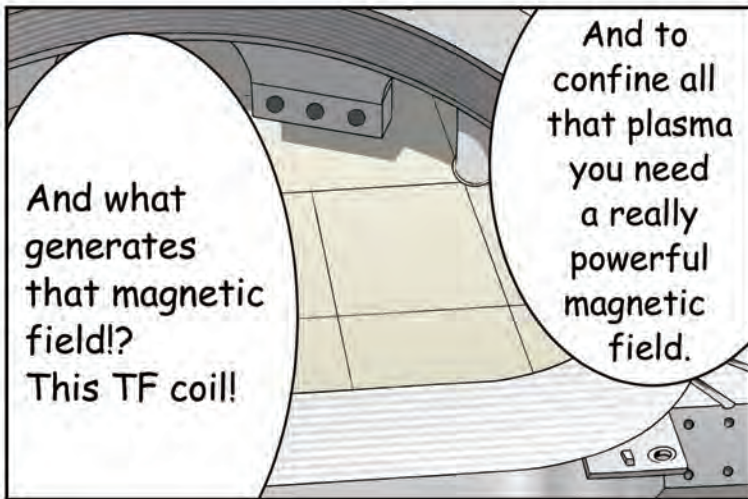
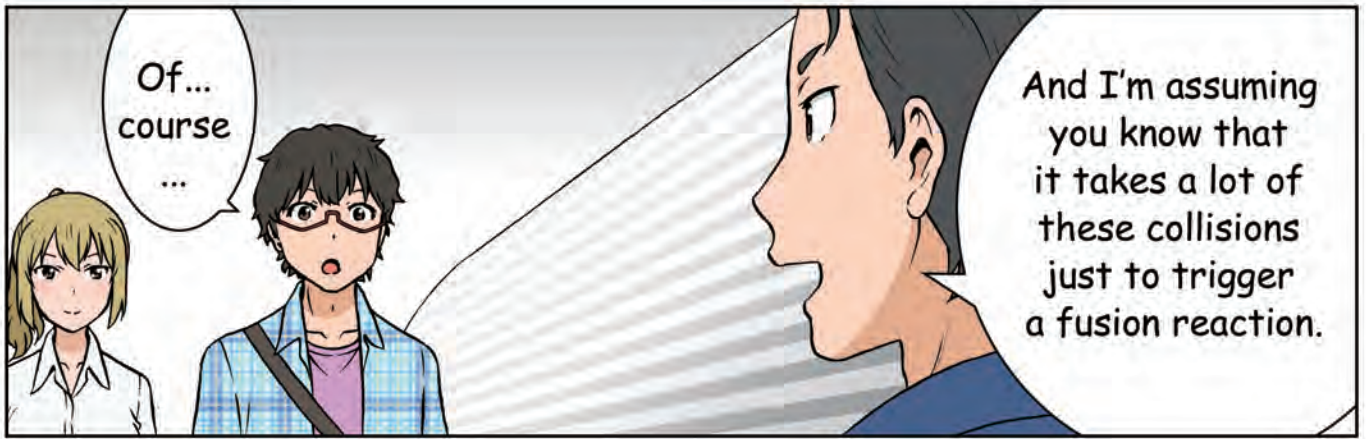
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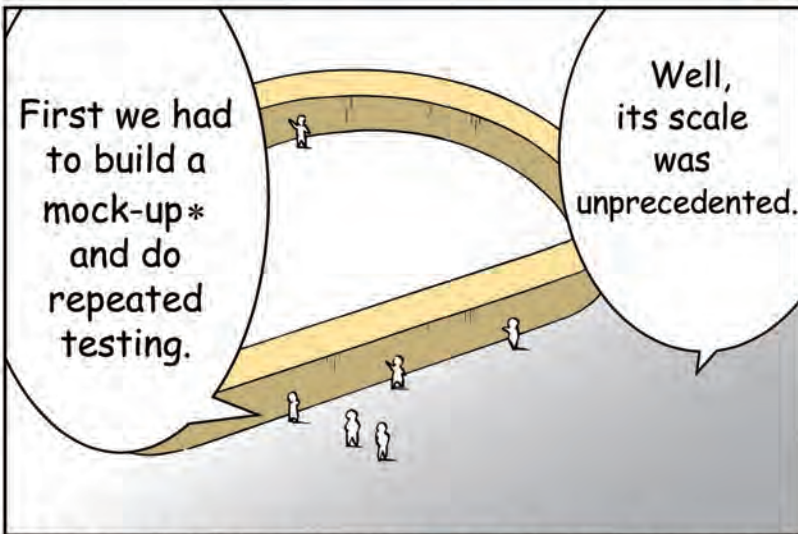
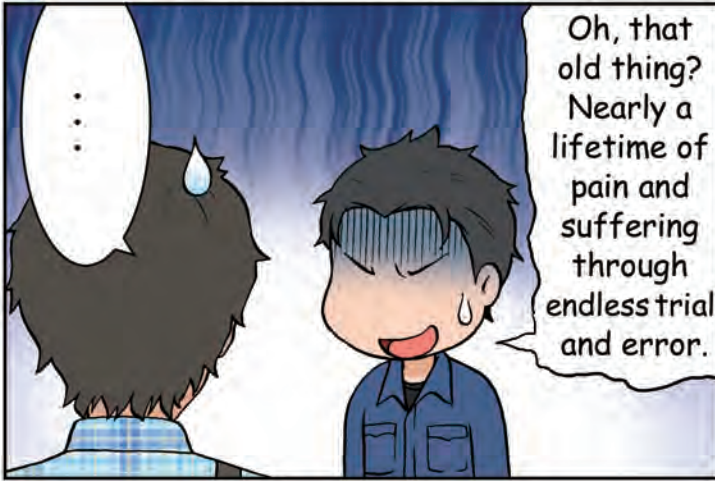


Come on in.

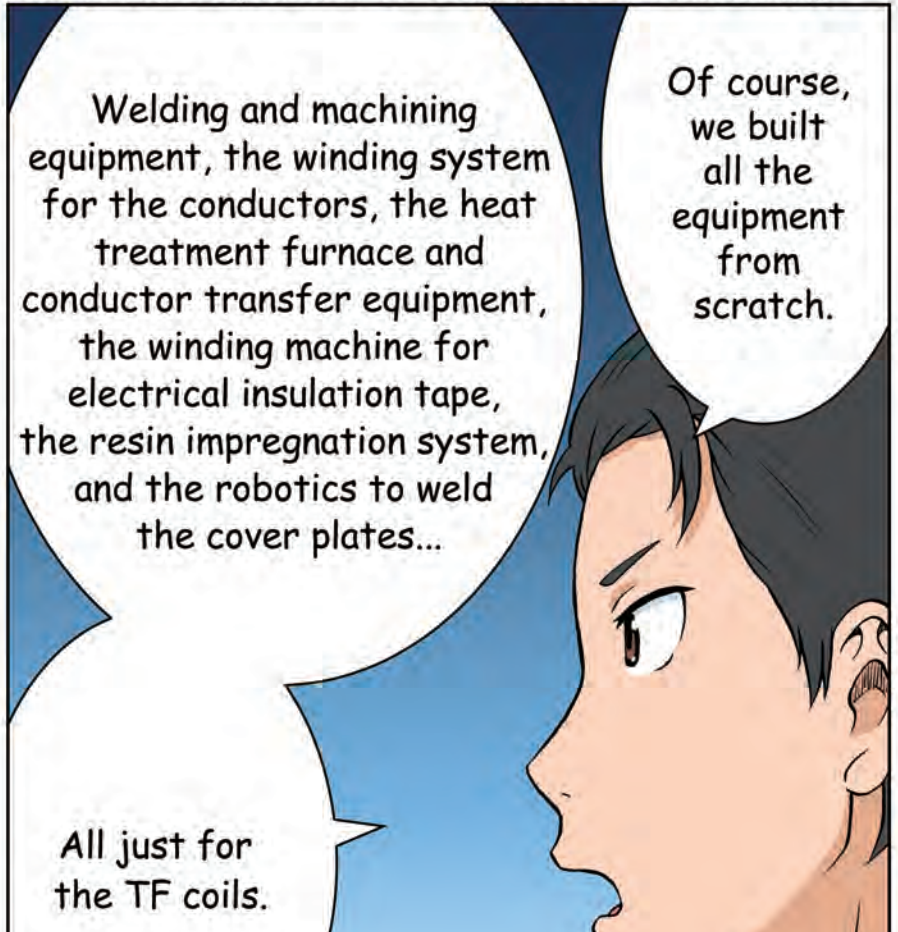
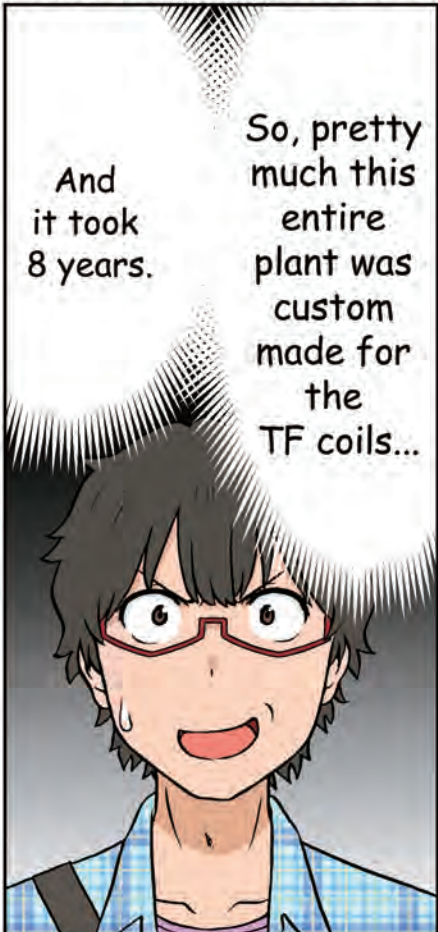








\* Full-scale prototype used to simulate the real component in the design phase of manufacturing





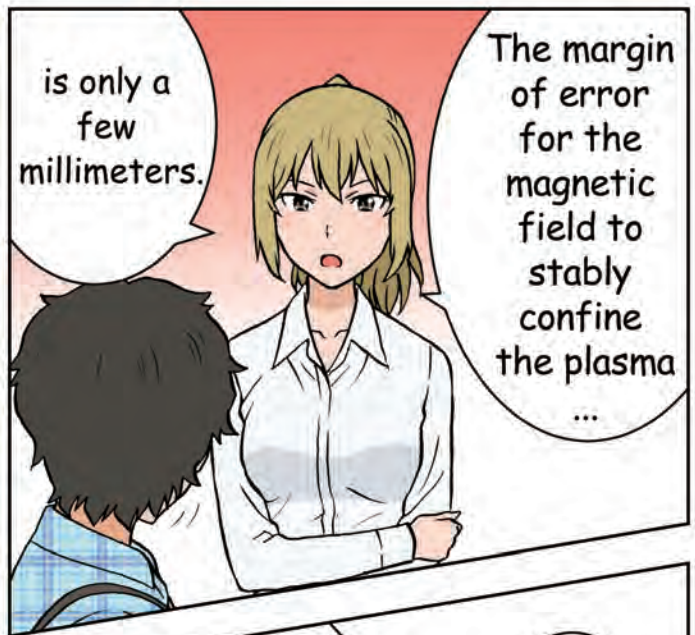
Level of precision ...?

The level of precision required for the dimensional tolerances gave us the most trouble.



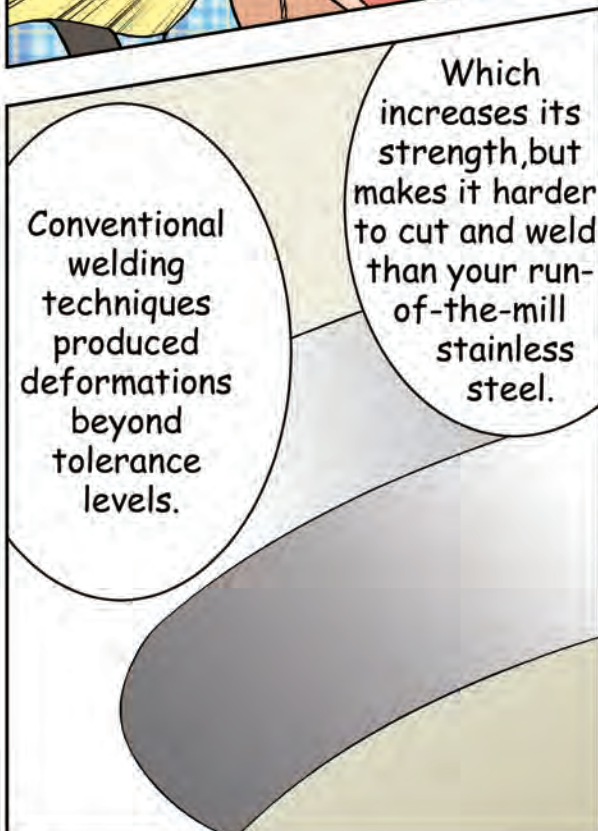
For this ginormous coil, you only have a few millimeters to work with?

A few millimeters!?



is only a few millimeters.

The margin of error for the magnetic field to stably confine the plasma ...



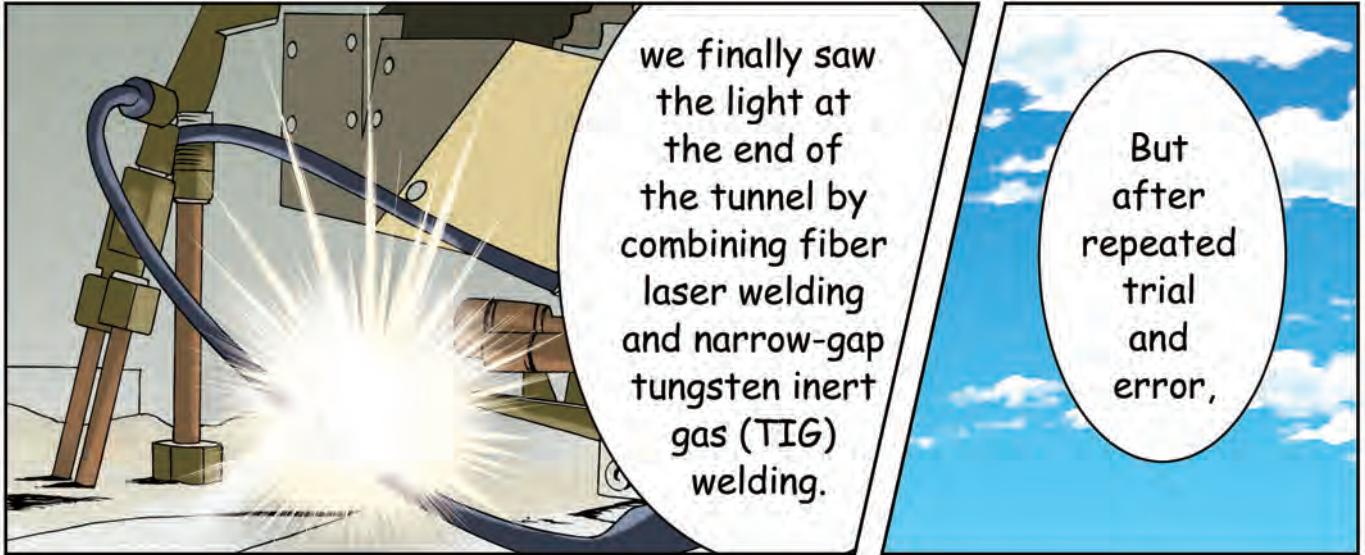
Conventional welding techniques produced deformations beyond tolerance levels.

Which increases its strength, but makes it harder to cut and weld than your run-of-the-mill stainless steel.



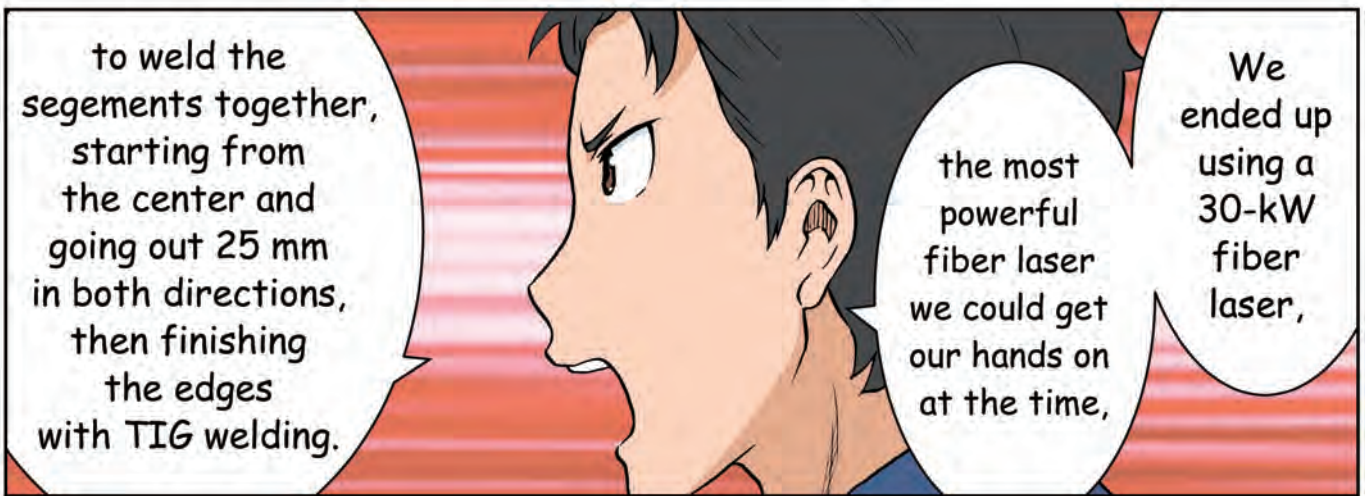
And the part that houses the TF coil conductors, the radial plate, is made from wrought high nitrogen stainless steel.

Yep



we finally saw the light at the end of the tunnel by combining fiber laser welding and narrow-gap tungsten inert gas (TIG) welding.

But after repeated trial and error,



to weld the segments together, starting from the center and going out 25 mm in both directions, then finishing the edges with TIG welding.

the most powerful fiber laser we could get our hands on at the time,

We ended up using a 30-kW fiber laser,

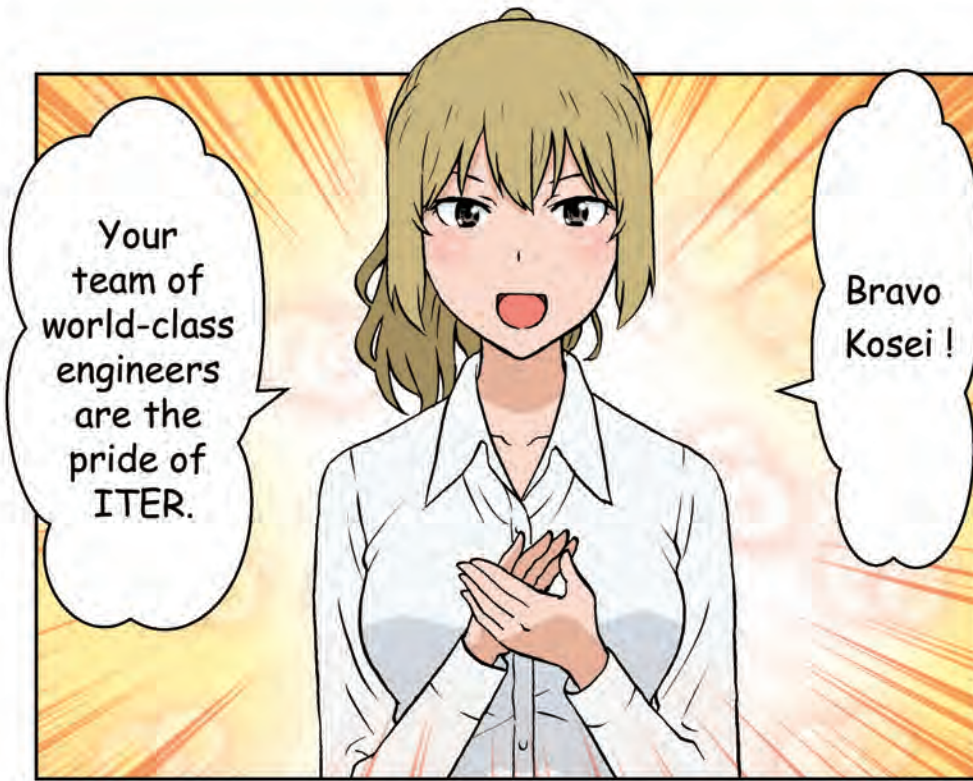


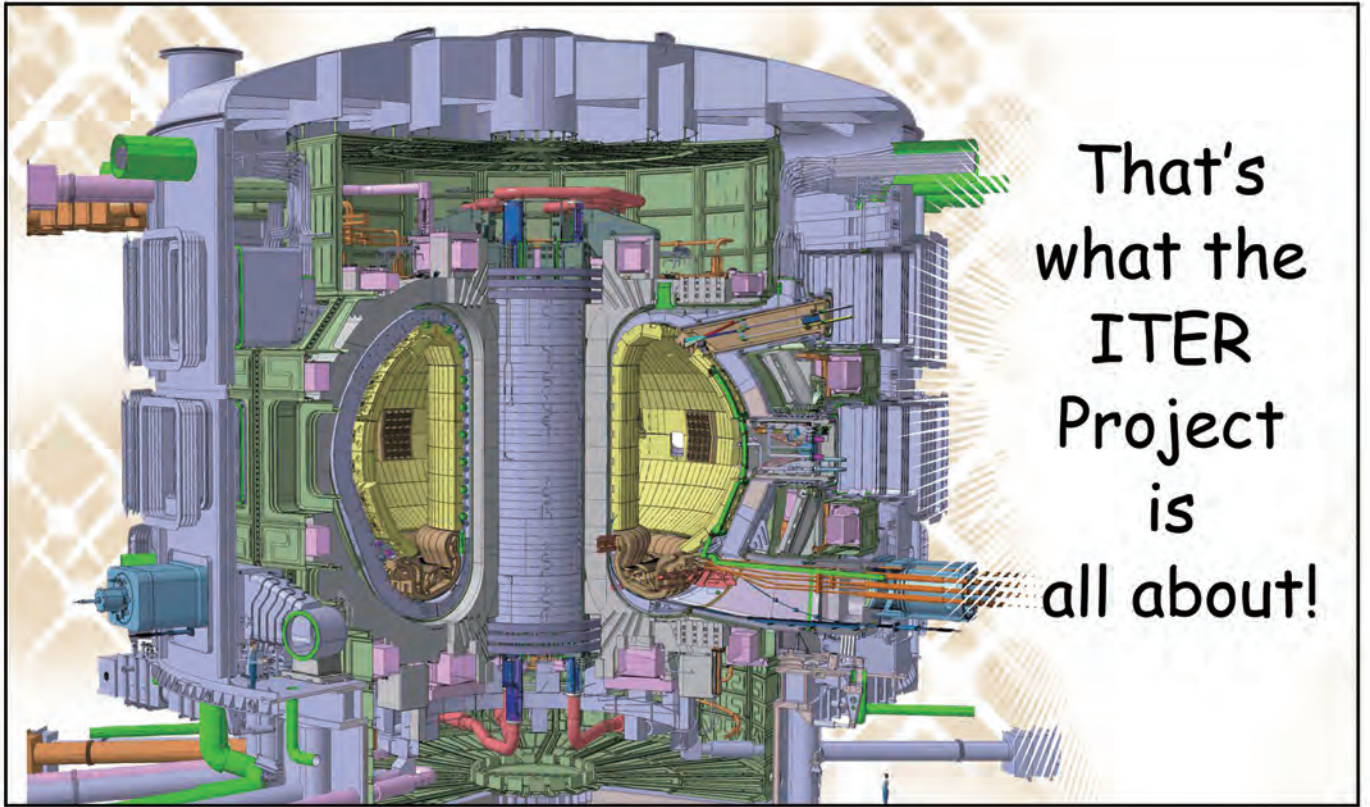
we were finally able to get the flatness tolerances under 1 mm!

After shedding much blood, sweat, and tears,

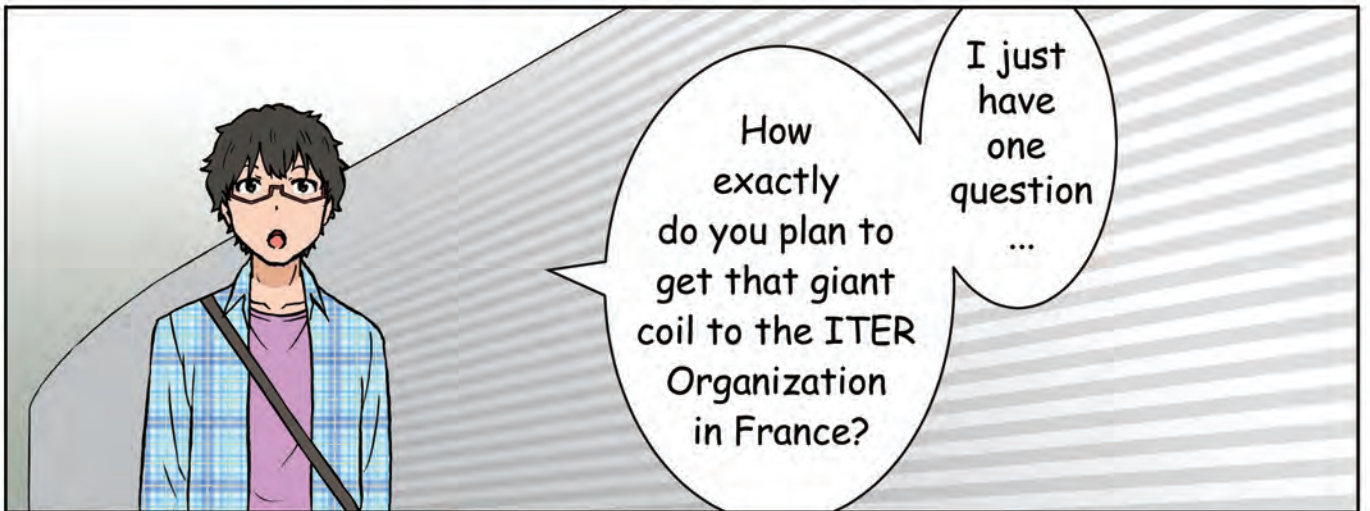


Silence...



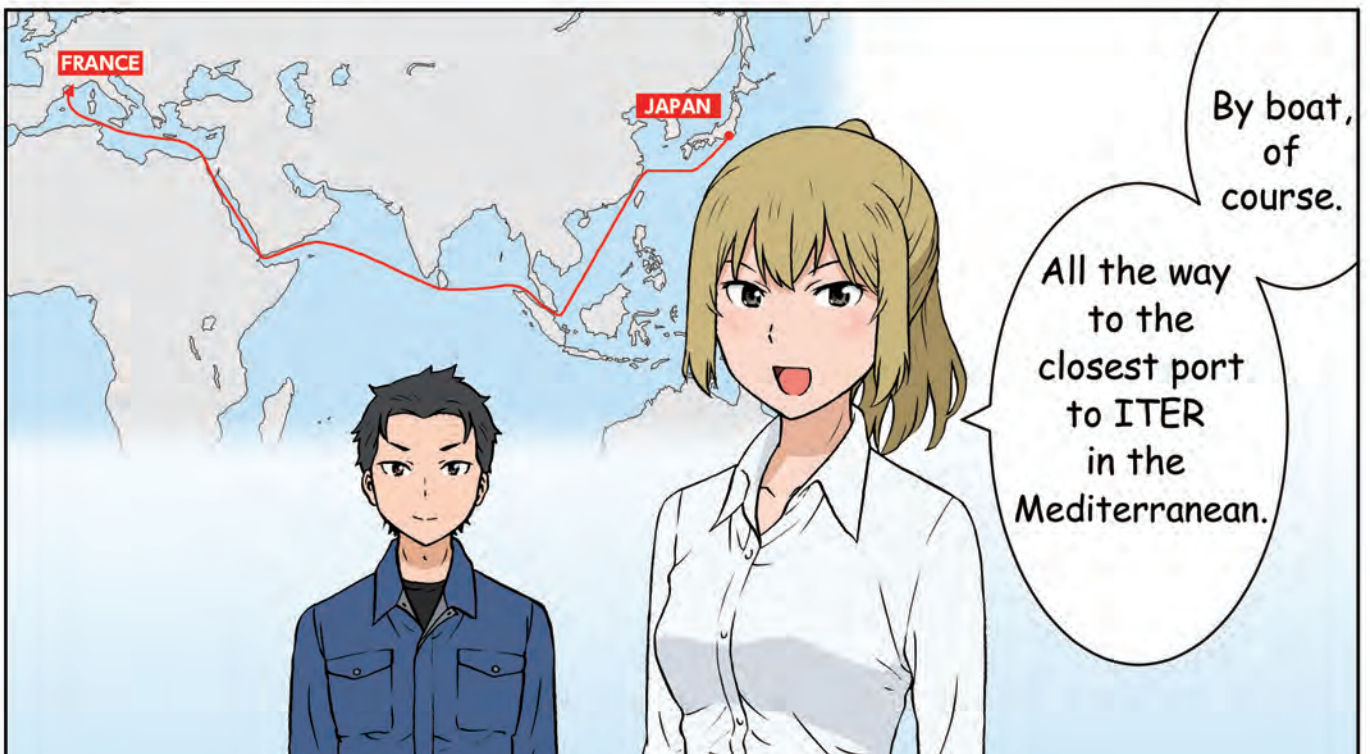


That's  
what the  
ITER  
Project  
is  
all about!



How  
exactly  
do you plan to  
get that giant  
coil to the ITER  
Organization  
in France?

I just  
have  
one  
question  
...



By boat,  
of  
course.

All the way  
to the  
closest port  
to ITER  
in the  
Mediterranean.



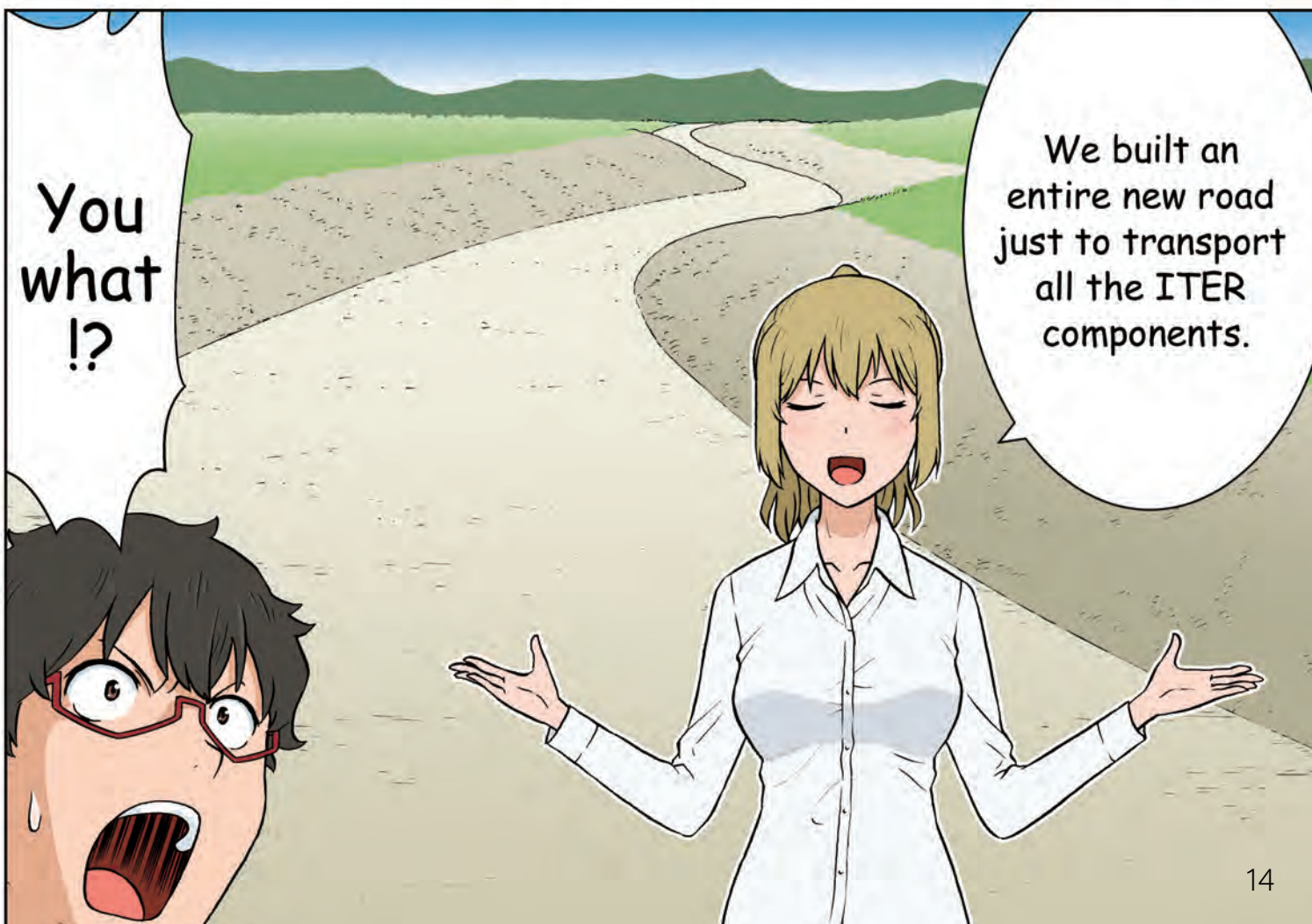
I don't see how you're going to get it there using the local roads...

I remember it was a bit of a ways from the port to ITER.

Yeah, but what about after that?



Au contraire

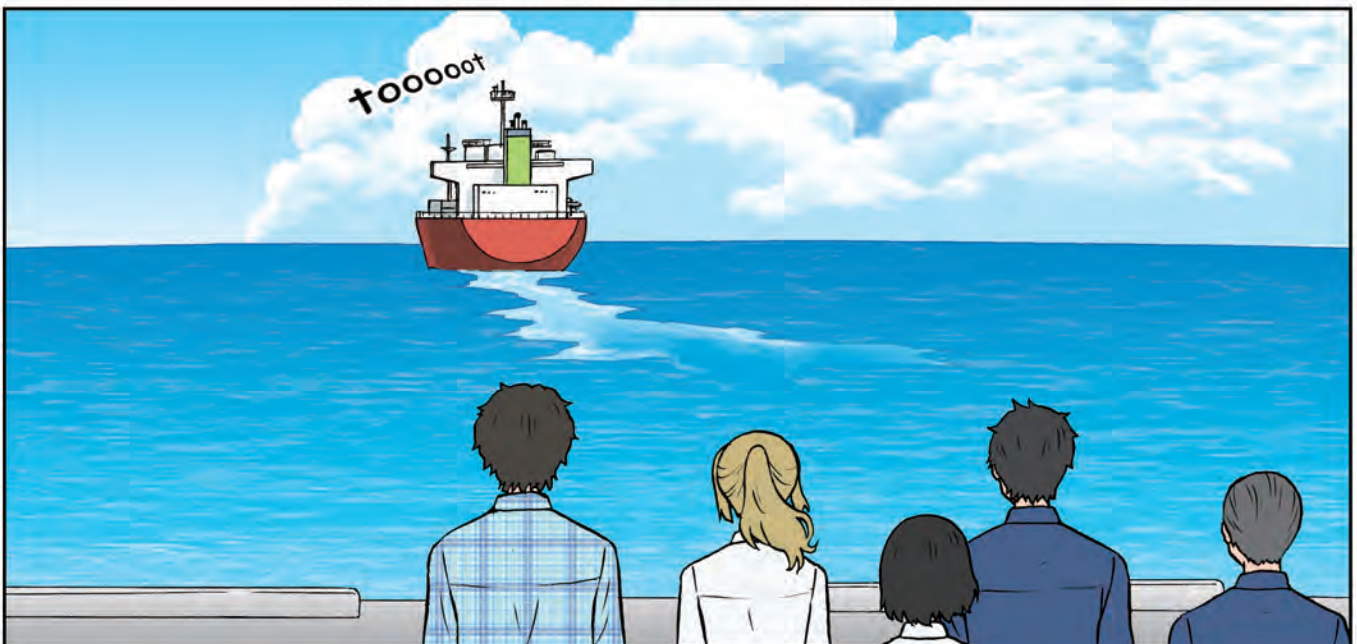
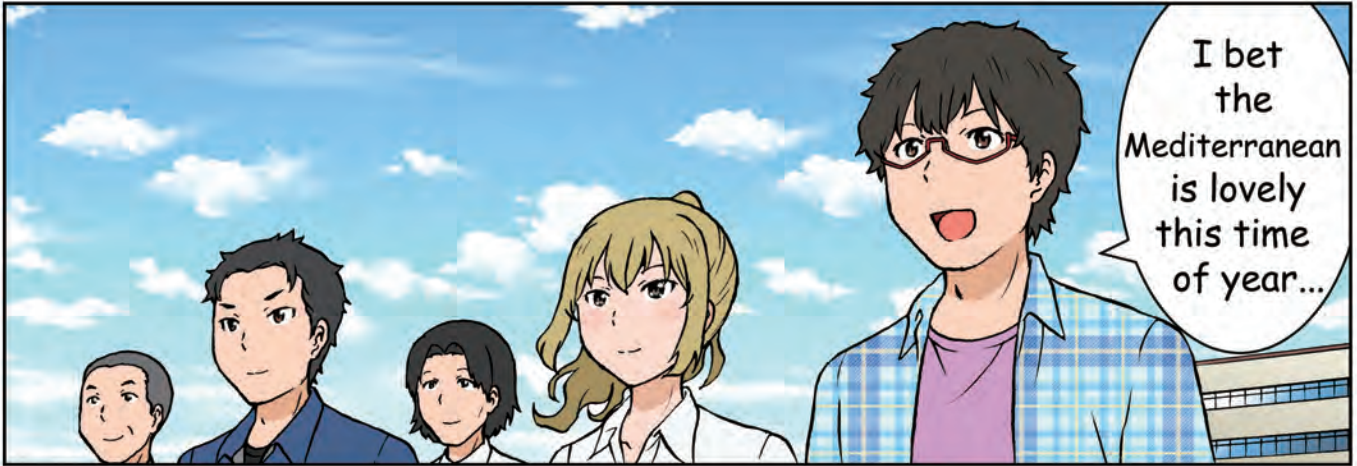
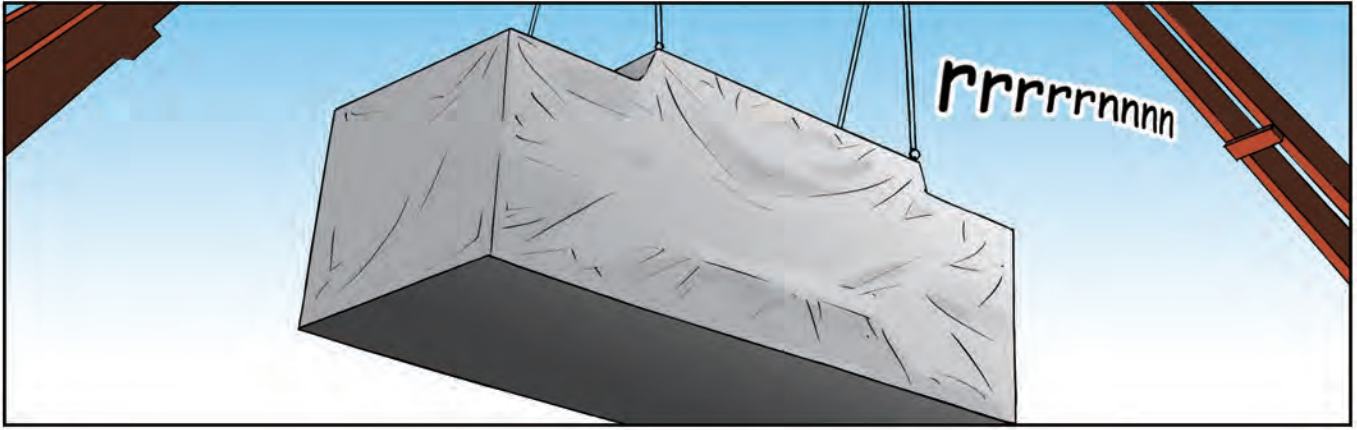


You what !?

We built an entire new road just to transport all the ITER components.







This story is fiction based on actual events

to be continued ...

# How ITER Toroidal Field (TF) Coils are made

Conductors are wound



and heat treated.



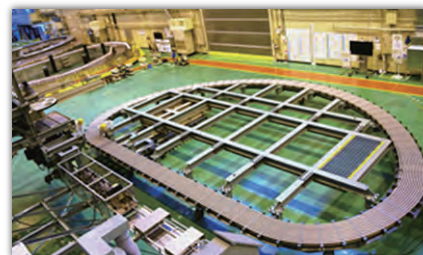
A radial plate is inserted



DPs are then stacked



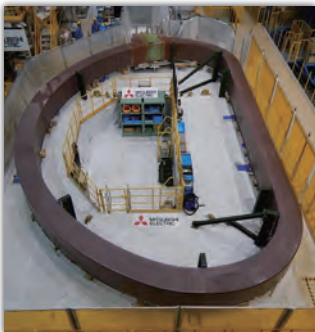
to form a double pancake (DP) module.



Fabrication of Radial Plate (RP)



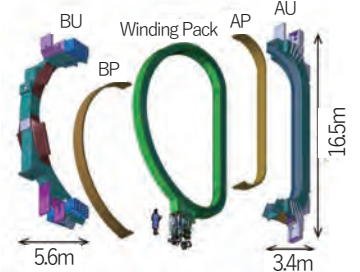
and impregnated with resin



to complete a winding pack.



Coil Sub-assemblies



AU...Inboard AP...AU Cover  
BU...Outboard BP...BU Cover

TF Coil Structure





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# A small Sun on Earth

## ITER ~ Vol.3 ~

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Publisher \_\_\_\_\_

A small Sun on Earth  
ITER Cartoon  
QR code



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

801-1 Mukoyama, Naka-shi, Ibaraki 311-0193 Japan

[Web] <https://www.qst.go.jp/site/fusion/>

[Tel] +81-(0)29-270-7213



ITER Japan Domestic Agency

<http://www.fusion.qst.go.jp/ITER/>

