

# Jumper connection & disconnection

kick-off meeting on the testing and magnetic measurements of the magnets for SuperFRS

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# Scope

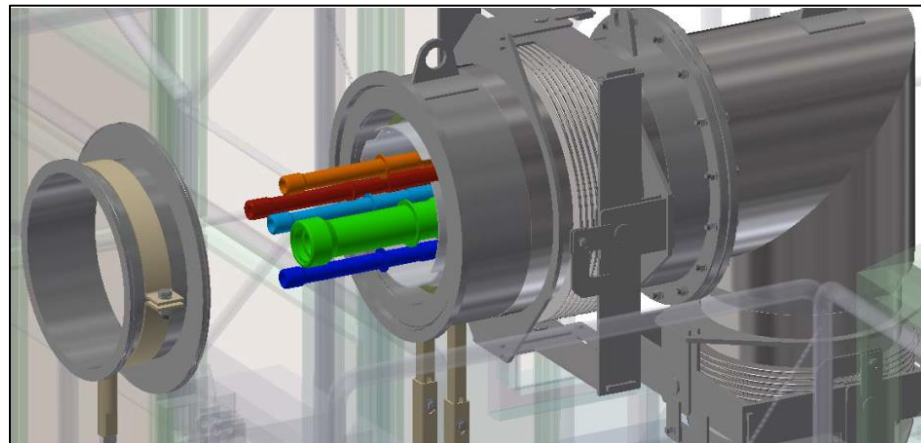
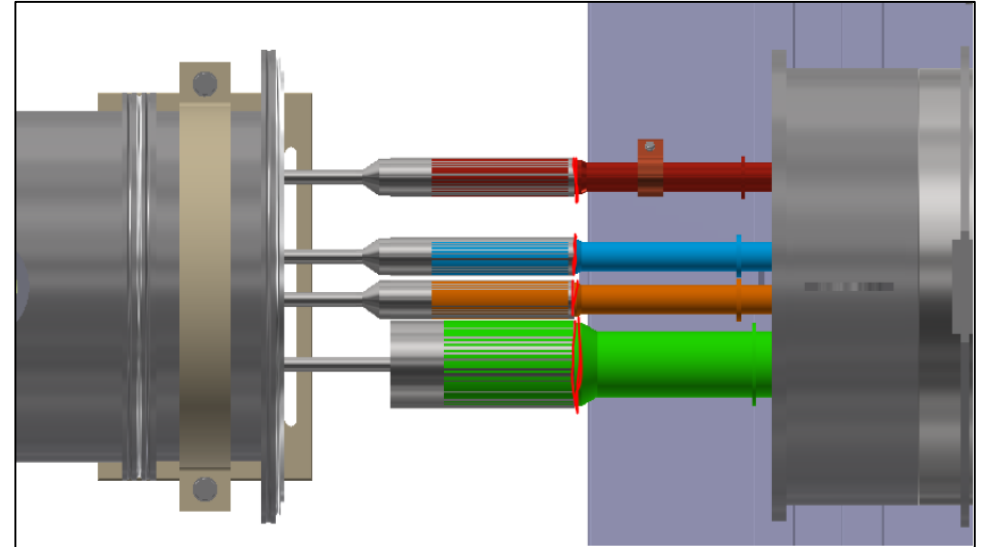
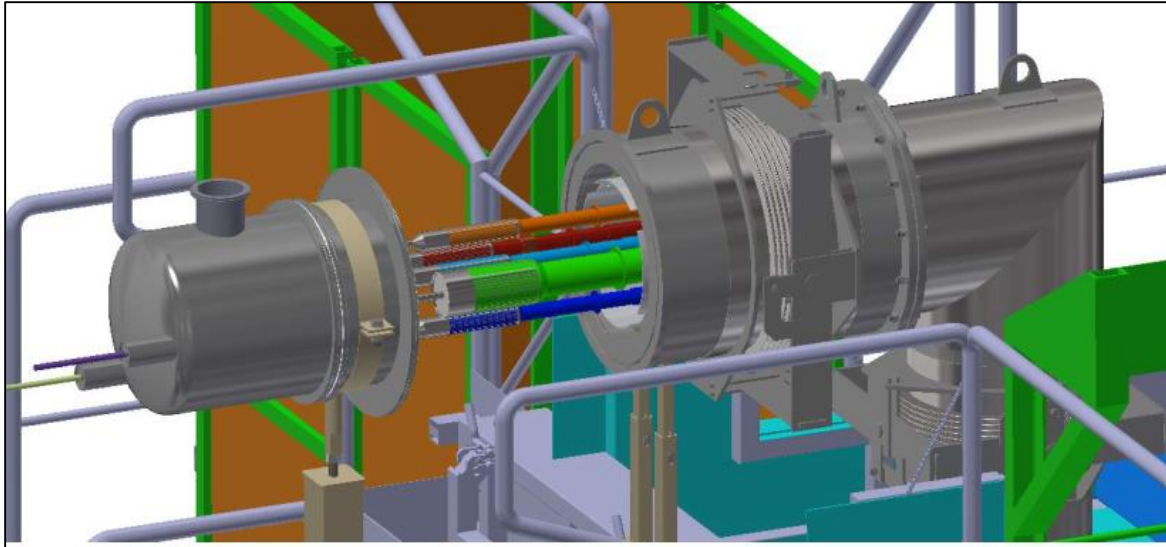
- Work carried out by EN-MME for the first magnet connection
- Lessons learnt
- EN-MME involvement foreseen for series production
- Estimated duration for welding and cutting operations for the series production

CHAMP MAGNETIQUE  
**DANGER**  
MAGNETIC FIELD

# Work carried out by EN-MME for the first magnet connection

## (1) Conditioning of the jumper end (first cryogenic bench)

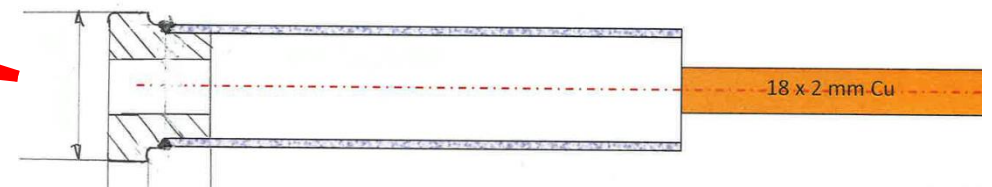
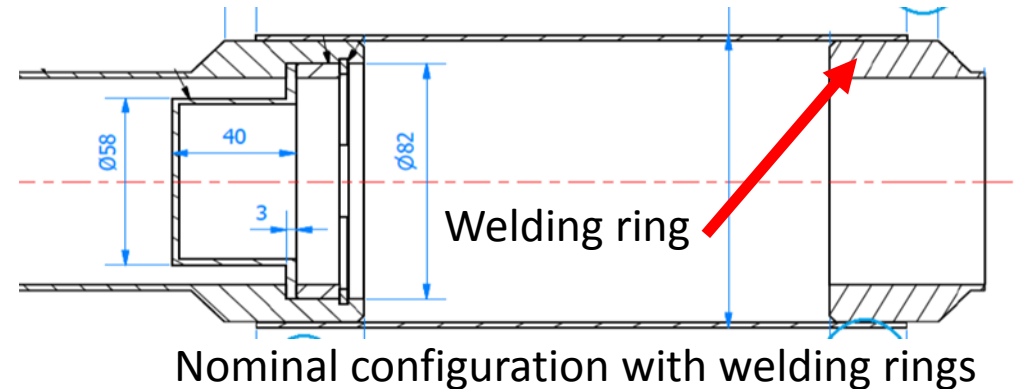
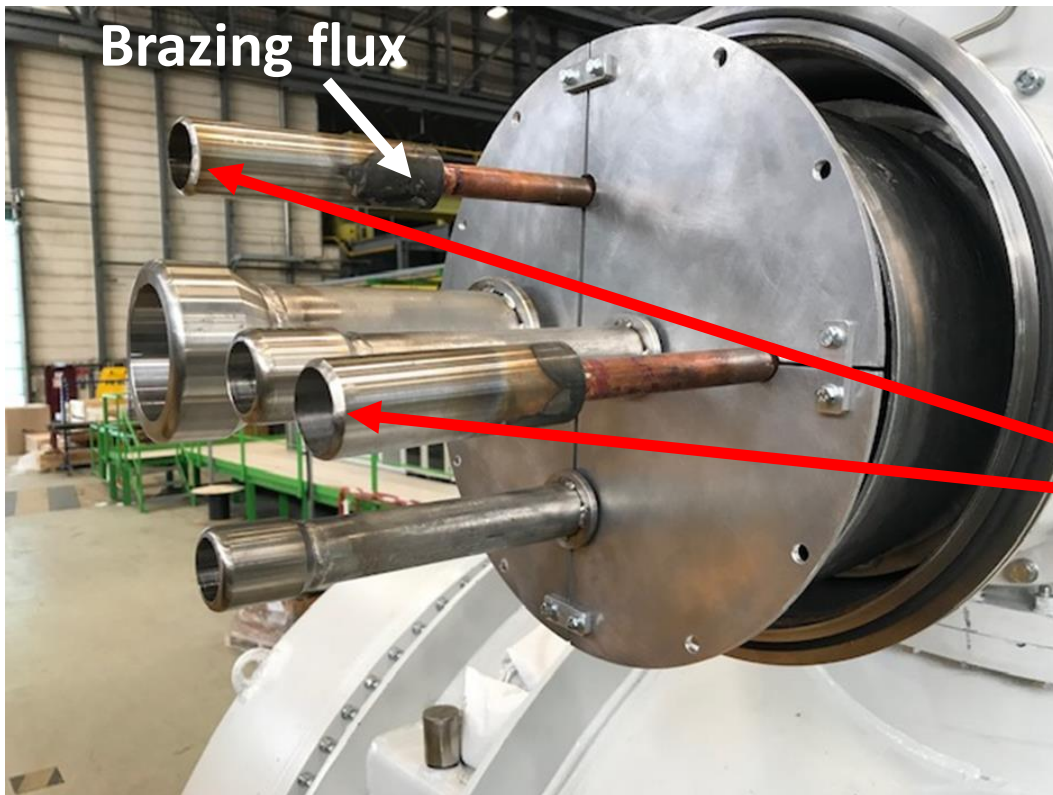
- Removal of the vacuum vessel dished head
- Cutting of the process pipe sleeves



# Work carried out by EN-MME for the first magnet connection

## (2) Preparation of the magnet process pipes

- Presence of brazing flux noticed, should be removed for the magnets in the future to avoid any risk of corrosion
- Non conformity of 2 process pipes extremities (welding rings missing), a dedicated solution has been implemented to restore the nominal configuration

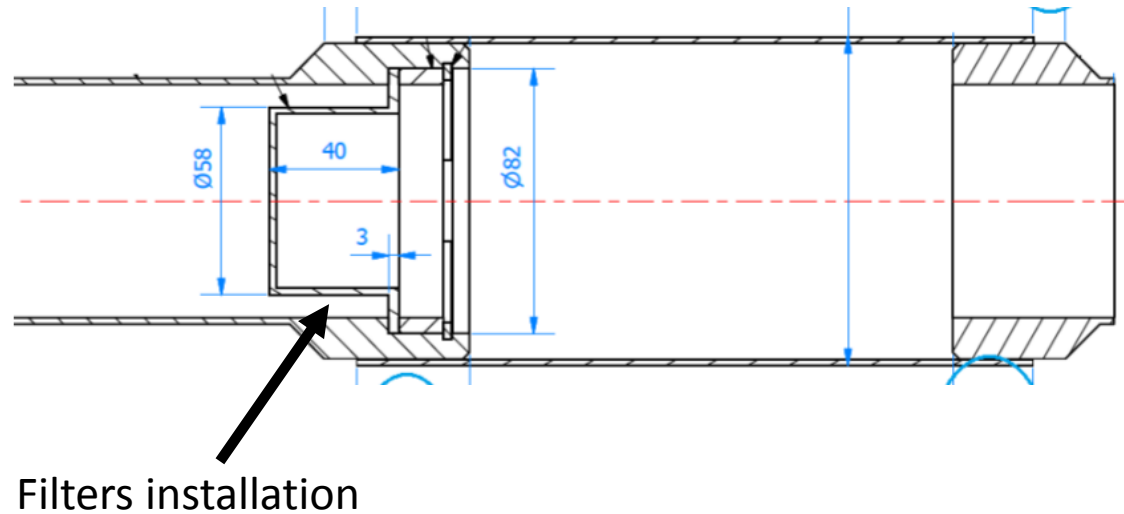


Welding of a dedicated ring to restore the nominal configuration – Welding with special care to avoid debrazing of the copper/SS junction -

# Work carried out by EN-MME for the first magnet connection

## (3) Preparation of the interconnect before welding

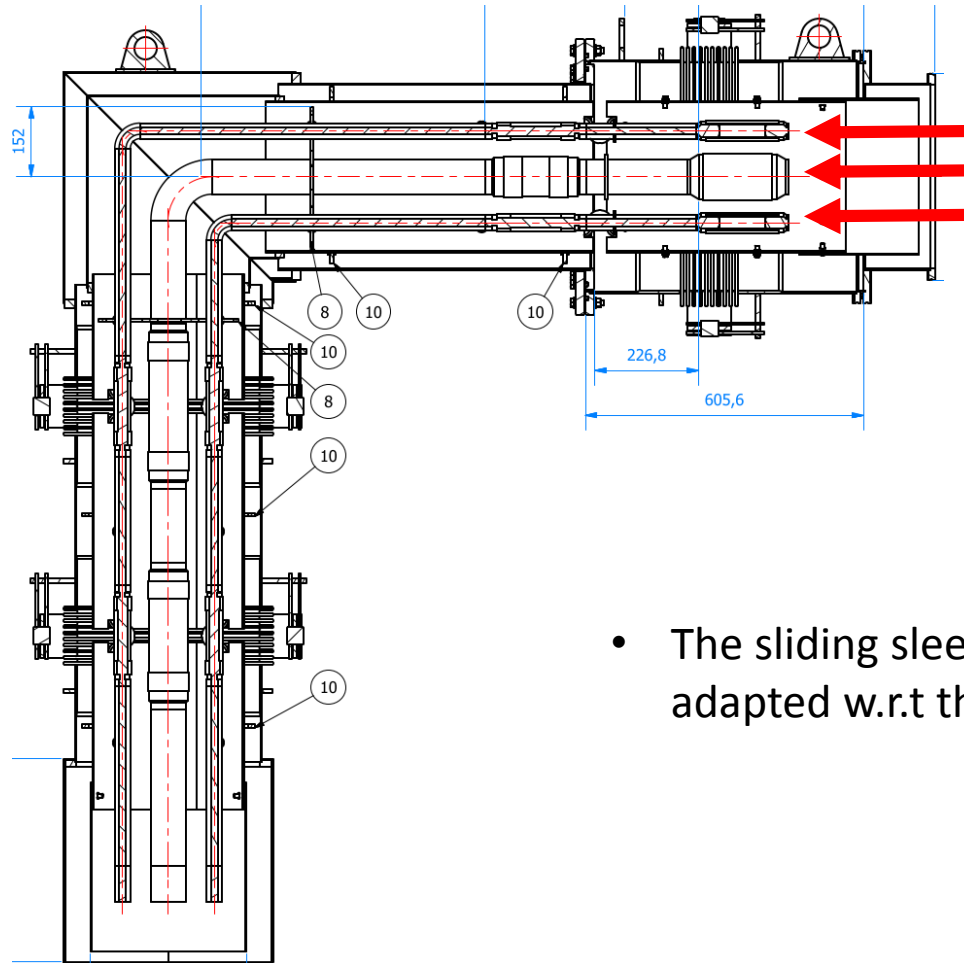
- Filters installation in 2 process pipes (jumper side)



# Work carried out by EN-MME for the first magnet connection

## (4) Preparation of the interconnect before welding

- Pre positioning of the process pipes to allow nominal position after the thermal shrinkage



Each process pipe has been “pushed” by  $\approx 20$  mm to allow the thermal shrinkage at cold without residual stress

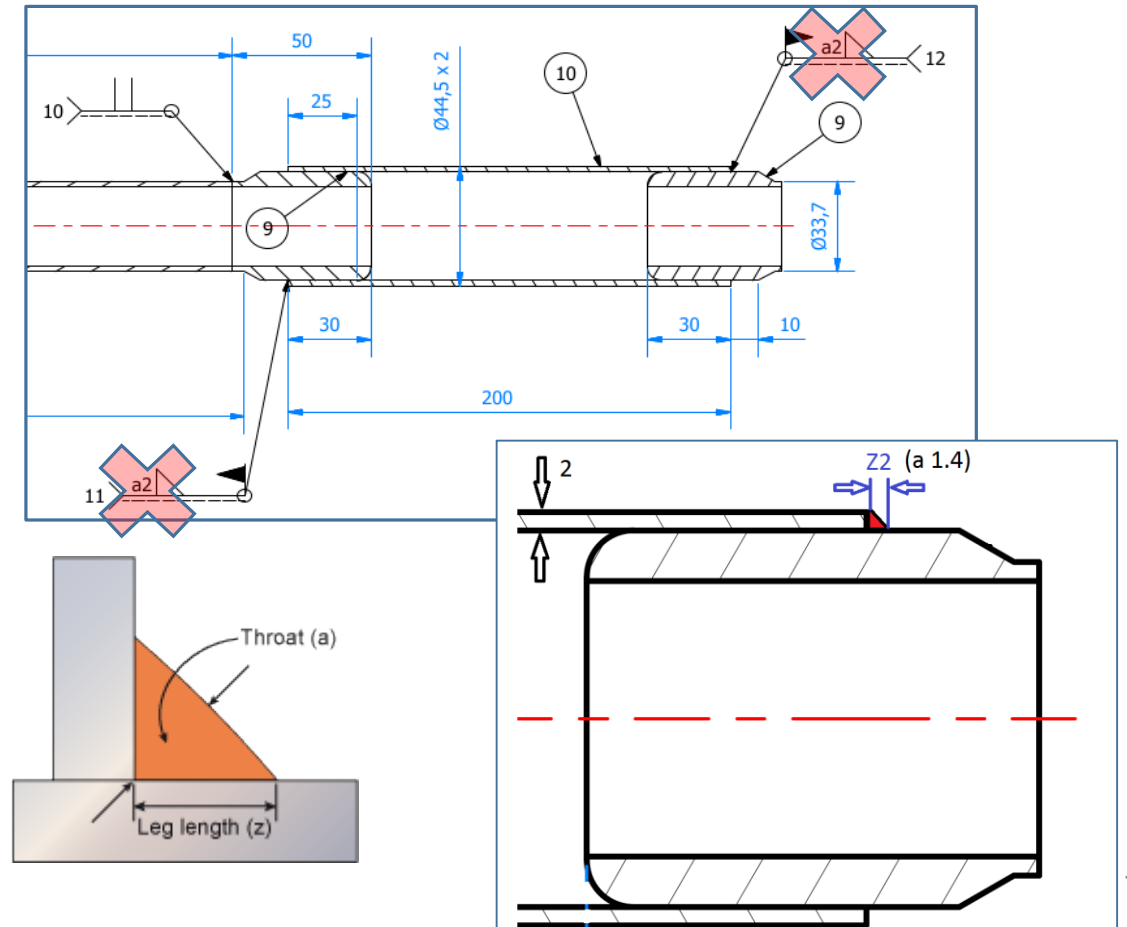
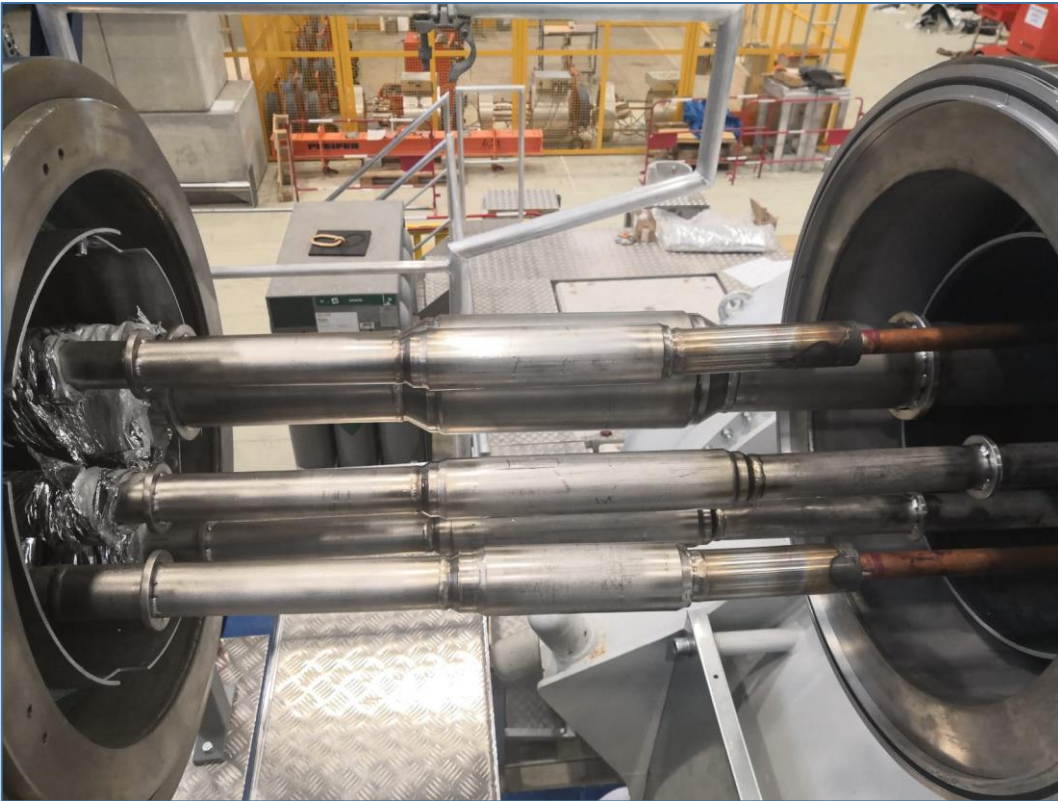
- The sliding sleeves length have been adapted w.r.t this position



# Work carried out by EN-MME for the first magnet connection

## (5) Welding of the interconnect & QC

- Orbital welding of the interconnect with a leg length of 2mm (z2). A throat thickness of 2 mm (a2) is not possible.
- Visual inspection by a MME certified inspector for welds quality control
- Leak test done by TE-VSC



# Work carried out by EN-MME for the first magnet connection

## (6) MLI installation

- MLI was missing around the magnet process pipes & the aluminum thermal screen. Installation was a difficult operation due to :
  - The poor accessibility
  - The strong off centering of the thermal screen with respect to the vacuum vessel. This did not allow the installation of 30 layers. Only 15 layers could be installed in the available gap.



poor accessibility

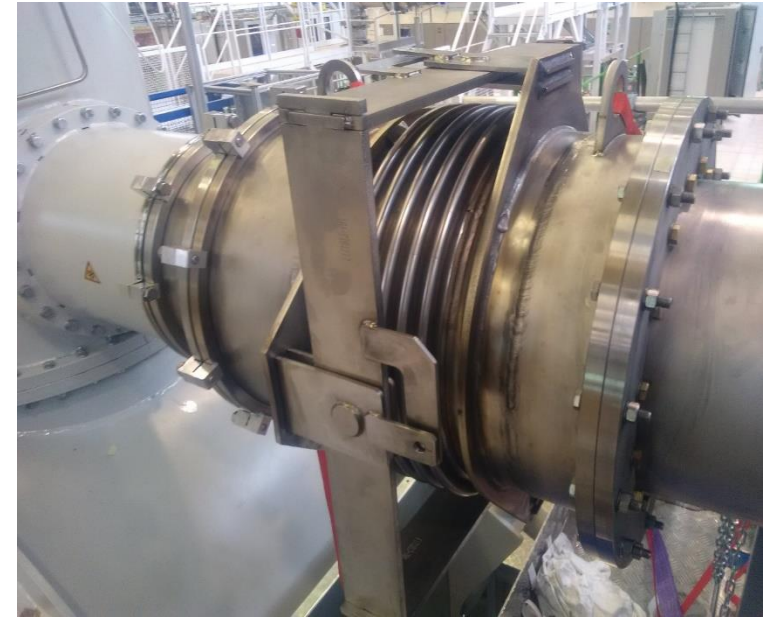
Insufficient gap for MLI installation (thermal screen/vacuum vessel interference with no possibility to move the thermal screen)



# Work carry out by EN-MME for the first magnet connection

## (7) Closure of the interconnect

- MLI installation around the sliding sleeves
- Aluminum thermal screen installation with MLI
- Vacuum vessel closure
- Leak test done by TE-VSC



# Lessons learnt

- Magnet side
  - Brazing flux should be carefully eliminated to avoid any risk of corrosion
  - Ensure that the nominal configuration is respected (welding rings at the process pipes extremities)
  - MLI should be installed on the process pipes & the thermal screen during fabrication (poor access later on)
- Interconnect
  - Process pipes shall be pre positioned (offset of 20 mm) to allow no residual stress after thermal shrinkage at cold
  - The sliding sleeves length shall be adapted accordingly

# EN-MME involvement foreseen for series production

Task	First magnet	Series
<b>Connection</b>		
Conditioning of the jumper extremity (benches 2 and 3)	EN-MME	EN-MME
Removal of the magnet vacuum dished head	EN-MME	?
Installation of MLI on magnet process pipes & thermal shield	EN-MME	?
Filters installation in 2 process pipes jumper side	EN-MME	?
Sliding sleeves preparation (length)	EN-MME	EN-MME
Orbital welding (or manual welding in case of gap non conformity) of the welding sleeves	EN-MME	EN-MME
Visual inspection of the welds by certified inspector	EN-MME	EN-MME
Leak test	TE-VSC	
MLI installation on sliding sleeves, thermal screen installation	EN-MME	?
Vacuum vessel closure (bellow)	EN-MME	?
leak test	TE-VSC	
<b>Disconnection</b>		
Jumper gimbal locking	?	?
Vacuum vessel opening	?	?
Thermal screen and MLI removal	?	?
Orbital cutting	EN-MME	EN-MME
Change of welding rings (jumper side) when needed		EN-MME

# Estimated duration for welding and cutting operations for the series production

- Connection
  - One day 2 technicians assuming that only preparation of sliding sleeves and welding operations have to be done
- Disconnection
  - One day 2 technicians assuming that only orbital cutting and reconfiguration of the process pipes jumper side have to be done

For information : connexion of the first magnet required almost 2 weeks for the all the tasks carried out by EN-MME